Zero Order Geodetic Network of Armenia Based on the GPS Campaign Carried out November 26th to December 1st 2002

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SWEDESURVEY

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Abbreviations and Acronyms

ARP	Antenna Reference Point. Point, to which the IGS community uses to refer the antenna height. For most of antennas it is at the centre of the bottom of the antenna.
CODE	Centre of Orbit Determination in Europe situated at the University of Berne. CODE is one of the processing centres of IGS.
EPN	EUREF Permanent Network.
ETRS 89	European Terrestrial Reference System 1989, common European Reference System based on ITRF converted back to epoch 1989.0.
EUREF	European Reference Frame, Sub-commission for Europe, Commission X of Section I of the IAG.
IERS	International Earth Rotation Service.
IAG	International Association of Geodesy.
IGS	International GPS Service. International network of permanent reference stations. The stations are run by national agencies, universities etc. and the data are offered for free to the international community. Data are provided to IERS for the ITRF solutions. Besides data IGS provides precise ephemeris and earth rotation parameters.
ITRF	IERS Terrestrial Reference Frame. Realisation of CTS published by IERS, based on VLBI, SLR, LLR and GPS measurements. Several different ITRF solutions have been made, e.g. ITRF 89, 91, 92, 93, 94, 96, 97 and ITRF 2000.
LLR	Lunar Laser Ranging.
RINEX	Receiver INdependent EXchange format (for GPS raw data).
RMS	Root Mean Square of residuals, approximately the same as standard error.
SCC	State Committee of the Real Property Cadastre of the Government of the Republic of Armenia.
SLR	Satellite Laser Ranging.
VLBI	Very Long Baseline Interferometry.
WGS 84	World Geodetic System 1984, a global reference frame used for the GPS system.

1 Executive Summary

This report deals with the processing of the Armenian zero order geodetic network and its connection to the International Terrestrial Reference Frame (ITRF) and the European Terrestrial Reference System (ETRS 89). 4 Armenian stations have been connected to 8 surrounding permanent GPS stations in the network of International GPS Service (IGS), which could be considered as the carrier of ITRF. The GPS campaign took place between November 26th and December 1st 2002. The IGS station NSSP (in Yerevan) was not in operation during the campaign, so the station was observed by SCC.

The processing was performed in the Bernese GPS Software ver 4.2, see appendix 10, according to the EUREF guidelines. Several different solutions were produced.

The constrained solution in ITRF 2000 epoch 2002.9, based on elevation dependent weighting, 10 degrees cut-off, dry Niell mapping function, is chosen as the final solution. This solution is converted into ETRS 89 following the EUREF guidelines. The final horizontal co-ordinates could be considered to be on the 1 cm-level (95%) at the epoch of the observations, which corresponds to the standard for class B EUREF stations (the highest level of non-permanent stations). The vertical accuracy is estimated to 2-3 cm (95%).

2 Introduction

This report deals with the processing and connection of the Armenian zero order GPS network to the International Terrestrial Reference Frame (ITRF) and the European Terrestrial Reference System (ETRS 89). 4 Armenian stations have been connected to 8 surrounding permanent GPS stations in the network of International GPS Service (IGS), which could be considered as the carrier of ITRF. Some of the IGS-stations are also included in EUREF Permanent Network (EPN).The GPS-campaign took place between November 26th and December 1st 2002.

A proposed zero order geodetic network in Armenia was originally observed in a GPS-campaign between September 29th and October 4th 2000. As data from the closest IGS stations NSSP and ANKR were not available at that time, and therefore the campaign hardly could be excepted by EUREF as a realization of ITRF, it was stated that the campaign should be repeated when it was certain that the surrounding stations, especially NSSP, were in operation.

This work is a part of the Swedesurvey project " Development of the Cadastral System in Armenia ". This project is funded by SIDA, Swedish International Development Agency, and the Armenian counterpart is State Committee of the Real Property Cadastre of the Government of the Republic of Armenia (SCC).

The processing has been carried out by Lotti Jivall, Lantmäteriet (the National Land Survey of Sweden), using the Bernese GPS Software, version 4.2.

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3 Description of the Campaign

3.1 Stations and sessions

The GPS campaign took place between November 26th and December 1st 2002.

The campaign consists of a total of 12 stations that have been recording continuously during the whole period. Of these the stations AMAS, KAPA, VARD and NOYE, observed by SCC, should be determined from the surrounding IGS-stations NSSP, ANKR, BAHR, GLSV, NICO, TRAB, ZECK and KIT3. The IGS station NSSP was not in operation during the campaign, so the station was observed by SCC as the rest of the Armenian stations. The location of the stations are shown in figure 1 and the full names in appendix 11.

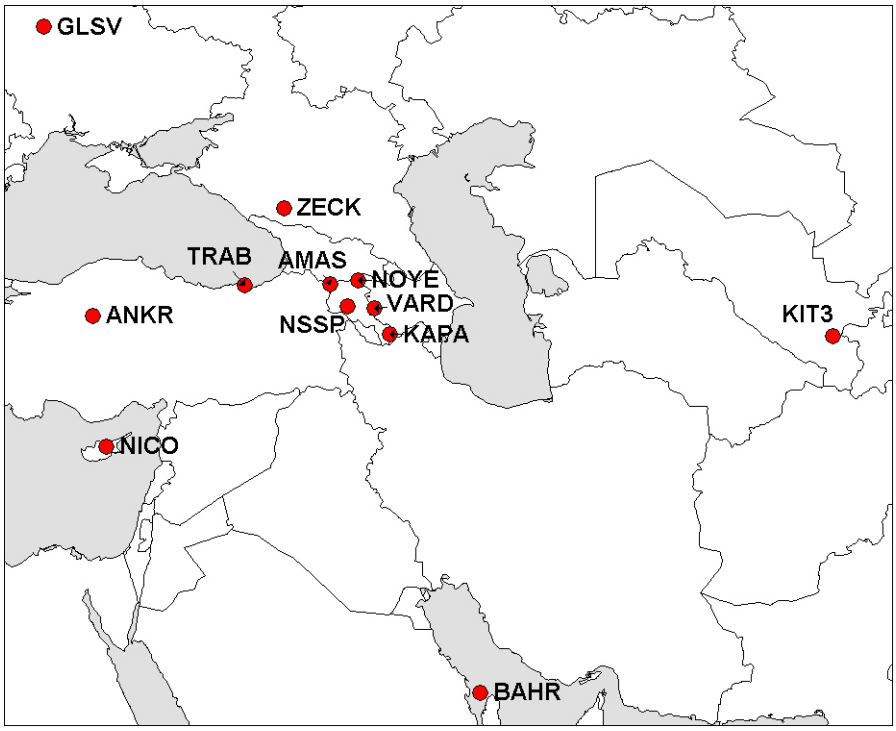

Figure 1: Stations included in the campaign.

The Armenian zero order stations are all monumented with concrete pillars.

The observation time was divided into five 24 hour sessions, with the first session starting 02:00 day 330 (November 26) 2002 (and the last ending 02:00 December 1 2002). Stations, observed sessions as well as tectonic plate (according to IGS log file) are to be found in table 1.

Table 1: Stations and sessions included in the campaign.

Stations	Type	Tectonic Plate	330	331	332	333	334
ANKR 20805M002	IGS	Eurasian (Anatolian)	X	X	X	X	X
BAHR 24901M002	IGS	Arab	X	X	X	X	X
GLSV 12356M001	IGS	Eurasian	X	X	X	X	X
KIT3 12334M001	IGS	Eurasian	X	X	X	X	X
NICO 14302M001	IGS	African	X	X	X	X	X
NSSP 12231M001	IGS	Anatolian	X	X	X	X	X
TRAB 20808M001	IGS	Eurasian (Anatolian)	X	X	X	X	X
ZECK 12351M001	IGS	Eurasian	X	X	X	X	X
AMAS	Zero order	Eurasian (Anatolian)?	X	X	X	X	X
KAPA	Zero order	Eurasian (Anatolian)?	X	X	X	X	X
NOYE	Zero order	Eurasian (Anatolian)?	X	X	X	X	X
VARD	Zero order	Eurasian (Anatolian)?	X	X	X	X	X

3.2 Receivers and antennas

Receiver and antenna types as well as antenna heights are shown in table 2. All receivers, antennas and antenna heights are constant during the whole campaign.

The antenna heights of the IGS stations are taken from the IGS logfiles. They are all vertical and referred to the Antenna Reference Point (ARP). Note that NSSP was specially observed for this campaign by SCC, i.e. the usual IGS equipment is not used. The antenna heights for all Armenian stations (including NSSP) are taken from the delivered RINEX file headers and then corrected to ARP. The antenna height of NSSP was reconstructed by Mr Bengt Andersson at a visit to the station in June 2003. The other antenna heights are corrected from the top of the antenna to ARP.

Table 2: Receivers, antennas and antenna heights (in metre).

STATION	ANT. H. (ARP)	RECEIVER	ANTENNA
AMAS	0.1952	LEICA SR520	LEIAT502
ANKR 20805M002	0.0600	AOA SNR-8000 ACT	AOAD/M_T
BAHR 24901M002	3.1220	ASHTECH Z-XII3	ASH700936B_M
GLSV 12356M001	0.0000	TRIMBLE 4000SSI	TRM29659.00
KAPA	0.1962	LEICA SR520	LEIAT502
KIT3 12334M001	0.0460	AOA SNR-8000 ACT	AOAD/M_T
NICO 14302M001	0.0500	AOA SNR-8000 ACT	AOAD/M_T
NOYE	0.1982	LEICA SR520	LEIAT502
NSSP	0.0827	LEICA SR520	LEIAT502
TRAB 20808M001	0.0610	ASHTECH Z-XII3	ASH700936D_M
VARD	0.1982	LEICA SR520	LEIAT502
ZECK 12351M001	0.0450	AOA SNR-8000 ACT	AOAD/M_T

4 Other Data Used by the Processing

4.1 ITRF and other apriori co-ordinates

The same reference frame should be used both for the processing and the orbits. The satellite orbits are given in ITRF 2000 current epoch, which mean that this reference frame should be used also for the processing.

Co-ordinates and velocities in ITRF 2000 epoch 1997.0 (from the IERS solution)for the IGS stations included in the campaign are shown in table 3 and 4. The co-ordinates in table 3 have been converted to epoch 2002.9 (epoch of the campaign) with the velocities in table 4.The resulting ITRF 2000 co-ordinates in epoch 2002.9 are found in table 5. The Bernese program COOVEL was used for the conversion.

Apriori co-ordinates for the unknown stations were originally taken from the RINEX-headers. Better apriori co-ordinates were obtained by iterating the processing before the final processing.

Table 3: ITRF 2000 epoch 1997.0 co-ordinates from IERS for the IGS stations.

LOCAL GEODETIC DATUM: ITRF00 EPOCH: 1997-01-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG		
	ANKR 20805M002 2	4121948.5935	2652187.9385	4069023.6849	I00	after	99:227
	BAHR 24901M002	3633909.0501	4425275.4668	2799861.2712	I00		
	GLSV 12356M001	3512889.1137	2068979.7628	4888903.1407	I00		
	KIT3 12334M001	1944945.3564	4556652.1925	4004325.9764	I00		
	NICO 14302M001	4359415.8493	2874116.9740	3650777.7123	I00		
	NSSP 12312M001	3478646.8424	3418805.7286	4097987.1161	I00		
	TRAB 20808M001	3705250.4924	3084421.5568	4162044.6361	I00		
	ZECK 12351M001	3451174.8801	3060335.3132	4391955.5676	I00		

Table 4: ITRF 2000 velocities from IERS for the IGS stations.

LOCAL GEODETIC DATUM: ITRF00

NUM	STATION NAME	VX (M/Y)	VY (M/Y)	VZ (M/Y)	FLAG	PLATE		
	ANKR 20805M002 2	-0.0088	-0.0023	0.0064	I00	EURA	after	99:227
	BAHR 24901M002	-0.0297	0.0091	0.0253	I00	ARAB		
	GLSV 12356M001	-0.0175	0.0151	0.0076	I00	EURA		
	KIT3 12334M001	-0.0272	0.0075	0.0022	I00	EURA		
	NICO 14302M001	-0.0135	0.0139	0.0138	I00	EURA		
	NSSP 12312M001	-0.0248	0.0158	0.0169	I00	EURA		
	TRAB 20808M001	-0.0047	0.0219	0.0240	I00	EURA		
	ZECK 12351M001	-0.0205	0.0167	0.0087	I00	EURA		

Table 5: ITRF 2000 epoch 2002.9 co-ordinates from IERS for the IGS stations.

LOCAL GEODETIC DATUM: ITRF00 EPOCH: 2002-11-27 12:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	
916	NSSP	3478646.6960	3418805.8219	4097987.2159	I00	
916	NSSP 12312M001	3478646.6960	3418805.8219	4097987.2159	I00	
136	KIT3 12334M001	1944945.1958	4556652.2368	4004325.9894	I00	
142	ZECK 12351M001	3451174.7591	3060335.4118	4391955.6190	I00	
139	GLSV 12356M001	3512889.0104	2068979.8520	4888903.1856	I00	
140	NICO 14302M001	4359415.7696	2874117.0561	3650777.7938	I00	
137	ANKR 20805M002	4121948.5415	2652187.9249	4069023.7227	I00	after 99:227
141	TRAB 20808M001	3705250.4647	3084421.6861	4162044.7778	I00	
138	BAHR 24901M002	3633908.8747	4425275.5205	2799861.4206	I00	

The information about tectonic plate in table 4 is contradictory to the information in the IGS logfiles.

4.2 Satellite orbits

All data were processed using final precise orbits from International GPS Service (IGS). The earth rotation parameters belonging to these orbits were used.

4.3 Antenna phase centre corrections

The antenna phase centre corrections for the antennas depend on the elevation and azimuth of the satellites and have been taken from the file PHAS_IGS.01, which is also used by the IGS. For the antenna LEIAT502 the antenna model from NGS (National Geodetic Survey) has been used. Relevant parts of the antenna correction file are found in appendix 1.

4.4 Other data

Ocean tide loading coefficients in the model FES99 provided by H-G Scherneck and M S Bos were used in the processing. No meteorological observations have been used.

5 Processing Strategy

The processing was performed with the Bernese GPS Software version 4.2. The processing strategy is similar to the strategy used in the processing of EUREF Permanent Network (EPN).

5.1 Processing for each session

1. Conversion of RINEX-data to Bernese format (RXOBV3).

2. Generation of standard orbits from precise ephemeris (PRETAB and ORBGEN).

3. Estimation of receiver clock offsets for each epoch (CODSPP). Satellite clock offsets from precise ephemeris (IGS) were used.

4. Creation of single differences of carrier phase data as a star from NSSP (SNGDIF).

5. Pre-processing of the single difference phase measurements using triple differences. In this step cycle slips are detected and removed (if possible), outliers are detected and removed and multiple ambiguities are introduced if needed (MAUPRP). Sampling rate 30 seconds.

6. A first double-difference float solution is performed, 10 degrees cut-off angle, elevation dependent weighting. Residuals are saved and screened. Outliers are rejected (GPSEST).

7. A second double difference float solution is performed. 10 degrees cut-off angle, elevation dependent weighting, one troposphere parameter estimated per hour and station, dry Niell mapping function (GPSEST).

8. A regional ionosphere model is derived from L4-observations (geometry free linear combination) (GPSEST).

9. Ambiguity resolution baseline by baseline with the QIF-strategy (Quasi Ionosphere-Free), using the ionosphere and troposphere models from previous steps. 10 degrees cut-off angle and elevation dependent weighting (GPSEST).

10. Final minimum constrained networks solution using ionosphere free linear combination and resolved ambiguities. 10 degrees cut-off angle, elevation dependent weighting, hourly troposphere parameters with dry Niell mapping function, 180 second data (GPSEST). This solution is performed according to the guidelines for EPN processing.

11. Additional final minimum constrained solution for comparison, 15 degrees cut-off, no elevation dependent weighting and Saastamoinen apriori troposphere model before troposphere estimations. 180 second data (GPSEST). This set-up agrees with the old standard solution of EPN.

12. The co-ordinates from the final solutions were fitted to the known ITRF 2000 epoch 2002.9 co-ordinates (table 5) with a 3 and 6-parameter transformation (HELMER).

13. Additional test-solution with 25 degrees cut-off, no elevation dependent weighting and Saastamoinen apriori troposphere model before troposphere estimations. degrees cut-off. 180 second data (GPSEST).

14. Additional test-solution with 15 degrees cut-off, no elevation dependent weighting and no troposphere estimations. 180 second data (GPSEST).

In all GPSEST runs the IGS station ZECK 1235M001 was constrained to its ITRF 2000 epoch 2002.9 co-ordinates (sigma 0.1 mm/component).

5.2 Combination of sessions

The final session wise normal equations (from step 10 and 11, respectively) were combined with the Bernese program ADDNEQ.. Both minimum constrained solutions with just ZECK constrained and constrained solutions, where all IGS-stations (that fit well with the known ITRF co-ordinates) were constrained (sigma 0.1 mm/co-ordinate) to IERS ITRF 2000 epoch 2002.9, were computed. The co-ordinates from the minimum constrained solutions were fitted to the known ITRF-co-ordinates.

Normal equations were saved.

6 Results

As mentioned above several alternative solutions were processed (different elevation cut-off angles with different options). The 10° solution with elevation dependent weighting and Dry Niell mapping function for the troposphere parameters was chosen as final solution. The main part of this chapter deals with the results from this solution. The analysis of the alternative solutions is left for section 6.6.

6.1 Quality of the daily solutions

The estimated unit weight errors and percentage of resolved ambiguities for each session are presented in table 6. The values look fine.

A summary of the processing of each session is found in appendix 2.

Table 6: RMS for float- and fixed-solutions and percentages of resolved ambiguities for the session solutions. Unit % and mm respectively.

Session	Res amb	RMS flt	RMS fix
330	85	1.1	1.2
331	81	1.1	1.1
332	81	1.1	1.1
333	77	1.1	1.2
334	78	1.1	1.2

6.2 Comparison between float and fixed solutions

The fixed and float solutions each session were compared with each other. A large difference between the co-ordinates from the fixed and the float solutions might be an indication of erroneous fixed ambiguities or lower data quality. The differences between the fixed and the float solutions could be found in appendix 3. The differences are small and no outliers are found.

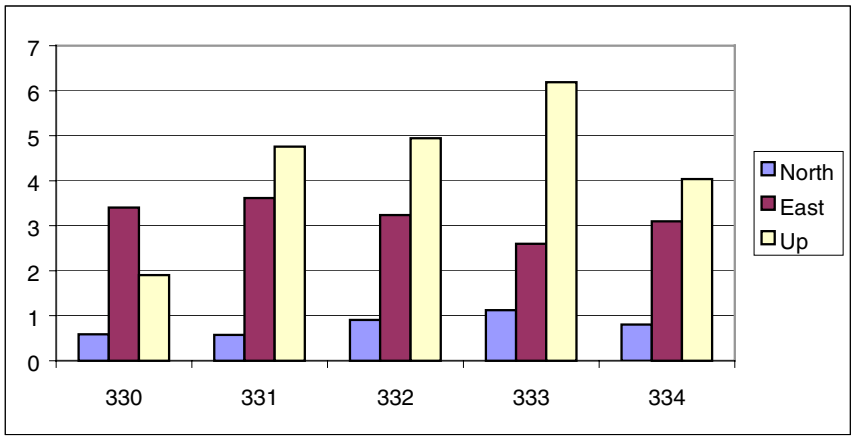

Figure 2: RMS of differences between fix and float solutions for sessions (mm).

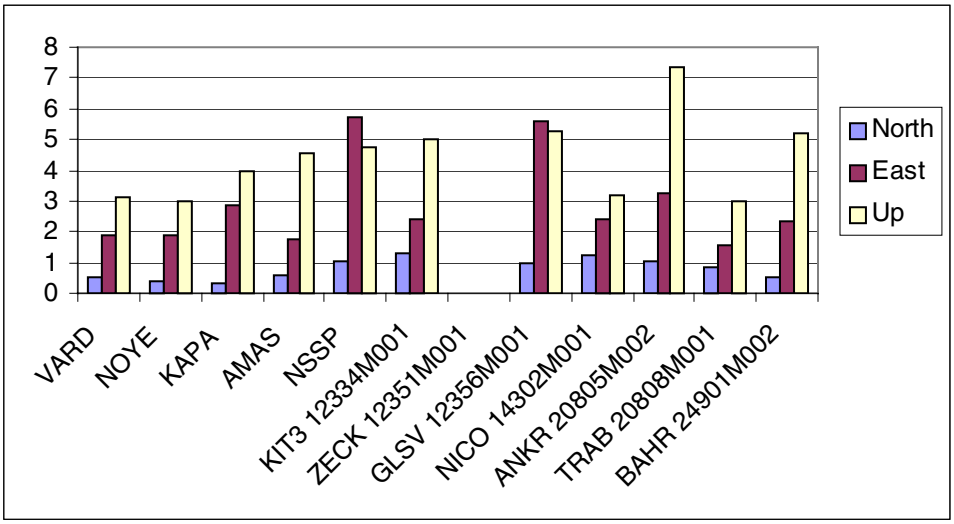

Figure 3: RMS of differences between fixed and float solutions for stations (mm).

6.3 Daily repeatability

The repeatability of the daily (session wise) fixed solutions was studied with the Bernese program COMPAR – see table 7. The residuals for each session (day) are the difference between the daily solution and the average of all sessions. Note that the compared solutions are minimum constrained solutions with just the station ZECK constrained. The RMS values are plotted in figure 4.

Table 7: Comparison of daily solutions. Unit: mm.

		rms	330	331	332	333	334
VARD	N	0,6	-0,2	0,1	-0,6	-0,4	1,1
	E	0,5	-0,5	-0,1	0,3	0,7	-0,4
	U	5,9	8,3	-5,6	-3,5	-3,4	4,2
NOYE	N	0,5	0	0,4	-0,3	-0,6	0,6
	E	0,4	-0,4	-0,1	0,1	0,6	-0,2
	U	5,3	5,8	4,7	-1	-6,8	-2,8
KAPA	N	0,9	0,5	-0,3	-0,9	-0,7	1,4
	E	0,9	-0,7	0,6	-0,4	1,2	-0,8
	U	9,7	16,9	-7,4	-3,2	-1,7	-4,6
AMAS	N	0,4	0,4	0,2	-0,4	-0,4	0,2
	E	0,6	-0,8	-0,1	0,6	0,6	-0,4
	U	3,2	3,6	-1	-0,9	-4,4	2,7
NSSP	N	0,7	0,1	0,4	0,1	-1,2	0,6
	E	1,9	-1,9	-1,7	-0,5	2,4	1,6
	U	5,8	3,6	-3,9	-7	-0,4	7,6
KIT3 12334M001	N	0,6	-0,1	0,4	-0,6	-0,6	0,9
	E	1,1	-1,2	-0,3	1,7	0,4	-0,6
	U	4,9	5,5	1,6	-1,5	2	-7,6
ZECK 12351M001	N	0	0	0	0	0	0
	E	0	0	0	0	0	0
	U	0	0	0	0	0	0

GLSV 12356M001	N	2,9	-1,7	-4,2	3,3	1,4	1,1
	E	1,1	-1	-0,2	-1	0,6	1,6
	U	7,7	5,4	10,6	-5,3	-7,1	-3,7
NICO 14302M001	N	0,6	0,8	0	-0,7	0,5	-0,5
	E	0,4	0	-0,1	-0,6	0,2	0,5
	U	4,6	3,9	2,3	-5,8	-4,2	3,8
BAHR 24901M002	N	1,1	0,7	0,7	-1,5	-0,9	1
	E	1,6	-0,5	1,3	-2,4	1,6	0,1
	U	5,6	8,3	1	-5,3	1,2	-5,2
ANKR 20805M002	N	0,5	0,5	-0,1	-0,8	0,1	0,4
	E	0,4	0	0,3	-0,7	0,2	0,2
	U	4,6	5,4	1,1	-6,4	-2,7	2,6
TRAB 20808M001	N	0,8	1,1	-0,5	-1	0	0,4
	E	0,9	-0,8	-0,8	0	1,3	0,4
	U	3,6	2,8	-4,8	-2,1	0,1	4

The repeatability looks fine in general. The height component of KAPA has a larger RMS than the other Armenian stations depending on a larger residual the first day. It is however not so large so there is any reason to exclude this station this day.

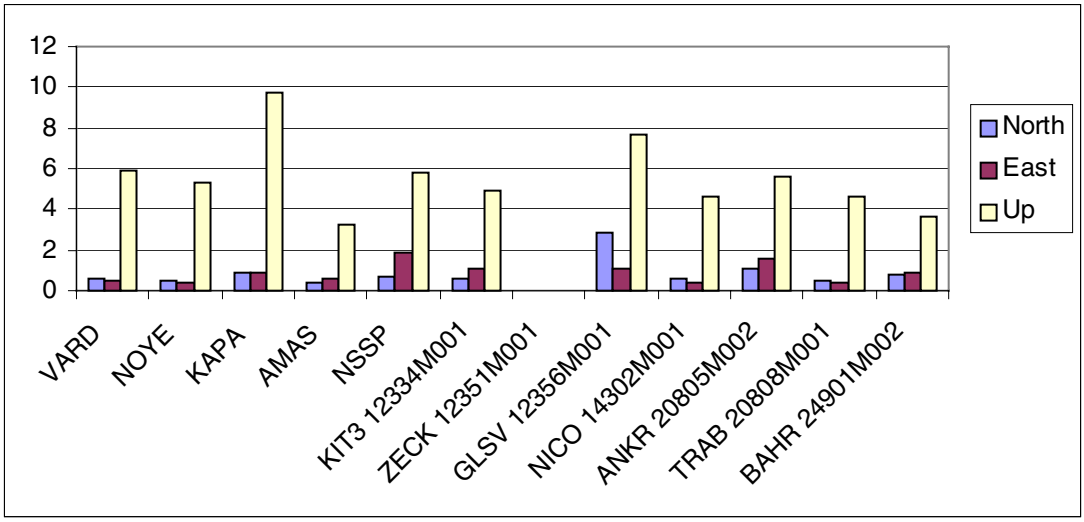

Figure 4: RMS of daily repeatability. Unit: mm.

The baseline repeatability in form of residuals from mean value for each baseline is plotted versus baseline length in figure 5-8. No outliers could be found.

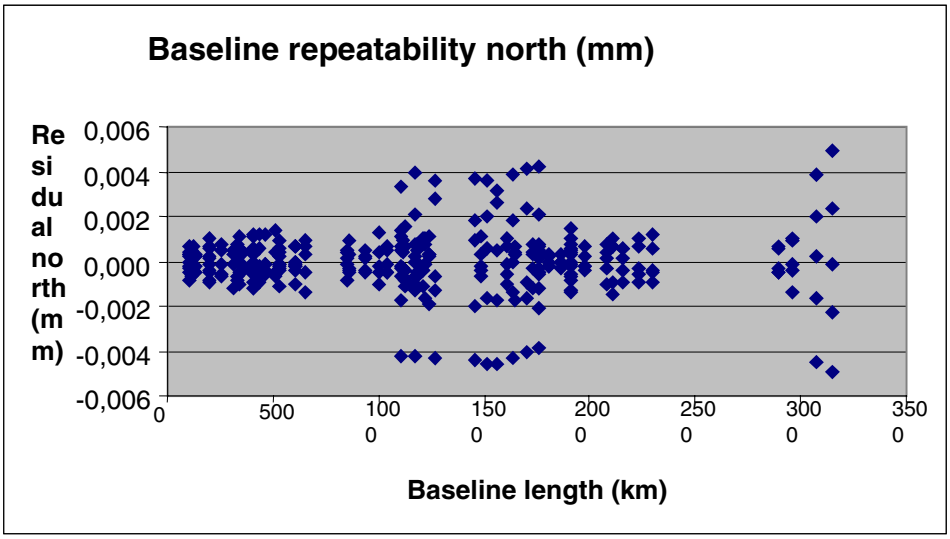

Figure 5: Baseline repeatability, residuals to mean value, north component. Unit: mm.

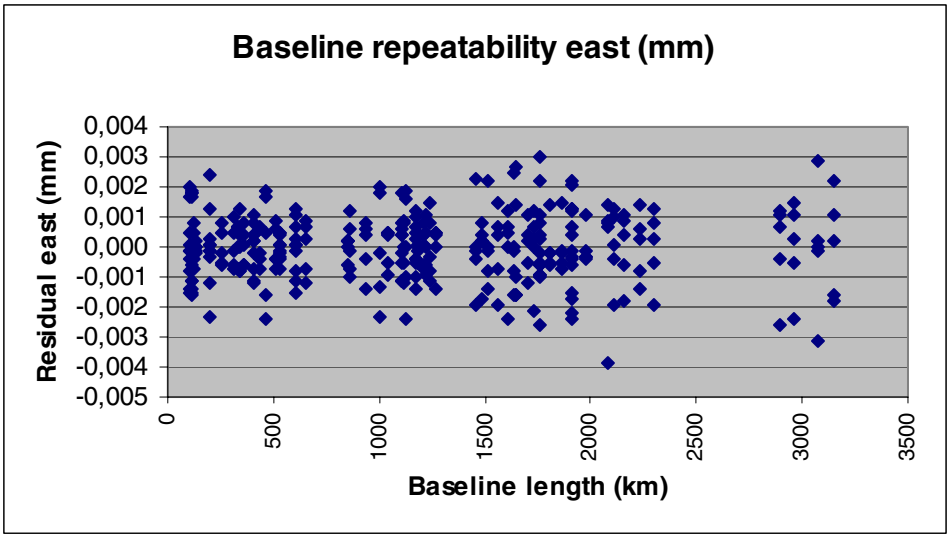

Figure 6: Baseline repeatability, residuals to mean value, east component. Unit: mm.

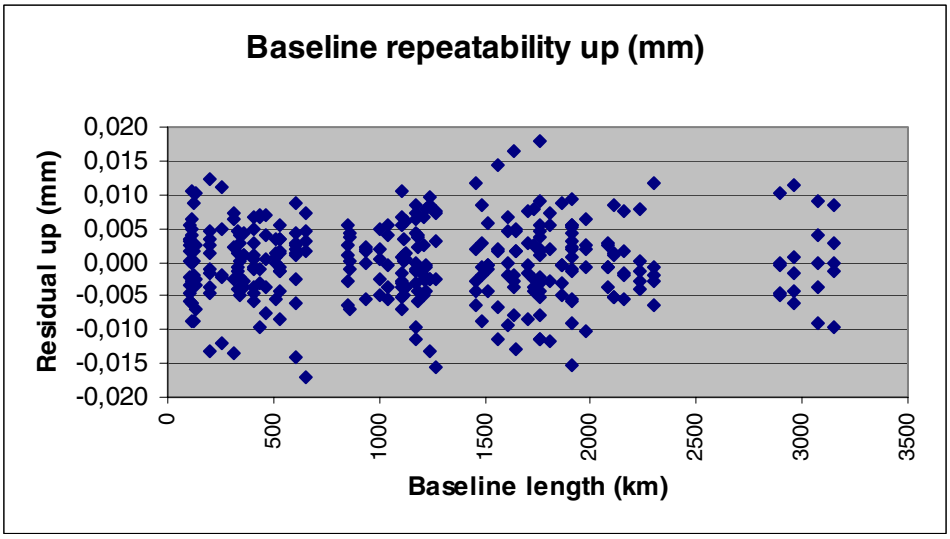

Figure 7: Baseline repeatability, residuals to mean value, up component. Unit: mm.

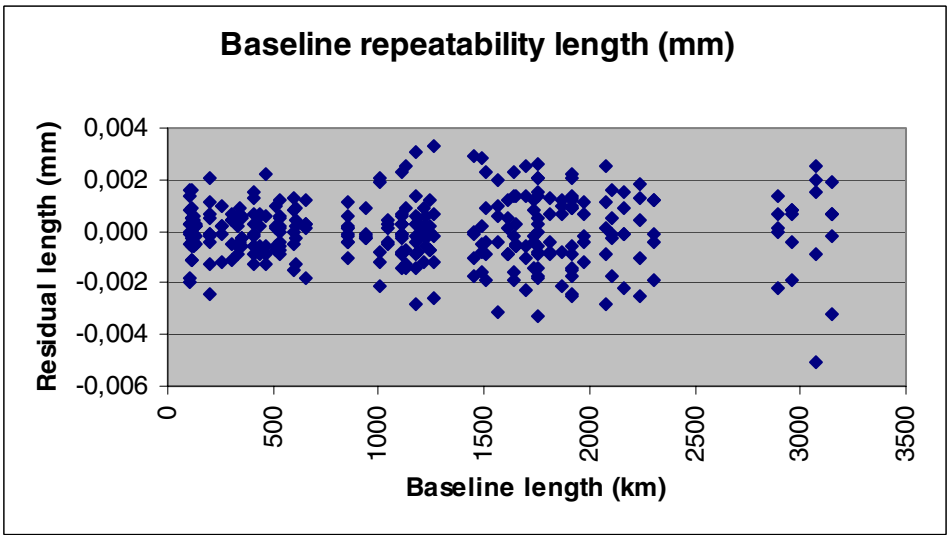

Figure 8: Baseline repeatability, residuals to mean value, length. Unit: mm.

6.4 Comparison with reference co-ordinates in ITRF 2000 epoch 2002.9

The session solutions and the combined minimum constrained solution were compared to the reference co-ordinates in table 5 by 3- and 6-parameter transformations. The residuals in the 3-parameter transformations for each session are found in appendix 4. The residuals for the combined minimum constrained solution are shown in table 8 and 9.

Both the session solutions and the combined minimum constrained solution did not fit the IERS ITRF solution on the stations TRAB and ANKR very well. As a test the minimum constrained solution was fitted to the EPN solution of the corresponding week (GPS week 1194). The agreement with the EPN solution was good – see table 10, which shows that there is nothing strange with our GPS processing on these stations. Finally TRAB and ANKR was excluded from the fits to ITRF – see table 11 and 12, where it could be seen that all other IGS stations fit well.

Table 8: Residuals in a 3-parameter fit of the minimum constrained solution to IERS ITRF 2000 epoch 2002.9. RMS = 16.3 mm.

Station	N(mm)	E(mm)	U(mm)
NSSP	1	3,3	-19
KIT3 12334M001	3,7	5,8	-6,9
ZECK 12351M001	-0,5	-1	-9,2
GLSV 12356M001	2,6	-3,2	3,5
NICO 14302M001	-2,4	0,9	5,7
ANKR 20805M002	-3	14,4	-31,9
TRAB 20808M001	1,4	-13,4	59
BAHR 24901M002	-3,3	-3,6	0,1
RMS / COMPONENT	2,6	8,1	26,8

Table 9: Residuals in a 6-parameter fit of the minimum constrained solution to IERS ITRF 2000 epoch 2002.9. RMS = 17.5 mm.

Station	N(mm)	E(mm)	U(mm)
NSSP	0,8	3,1	-18,7
KIT3 12334M001	2,1	4,5	-2,5
ZECK 12351M001	-0,5	-0,8	-9,2
GLSV 12356M001	3,8	-2,3	2,3
NICO 14302M001	-1,9	0,1	3,6
ANKR 20805M002	-2,3	14	-33,7
TRAB 20808M001	1,6	-13,6	58,5
BAHR 24901M002	-3,7	-4,9	1
RMS / COMPONENT	2,5	7,9	26,8

Table 10: Residuals in a 3-parameter fit of the minimum constrained solution to the EPN solution of GPS week 1194. RMS = 2.7 mm.

Station	N(mm)	E(mm)	U(mm)
ANKR 20805M002	0,1	-0,2	-1,3
GLSV 12356M001	-1,8	0,6	6
ZECK 12351M001	-1	0,4	-1,3
NICO 14302M001	1,3	-0,2	-5,9
TRAB 20808M001	-0,1	-0,4	2
RMS / COMPONENT	1,2	0,4	4,4

Table 11: Residuals in a 3-parameter fit of the minimum constrained solution to IERS ITRF 2000 epoch 2002.9. TRAB and ANKR excluded. RMS = 5.8 mm.

Station	N(mm)	E(mm)	U(mm)
NSSP	0,7	3,6	-14,3
KIT3 12334M001	3,5	4,6	-2,3
ZECK 12351M001	-1,1	-0,5	-4,4
GLSV 12356M001	1,6	-2	8
NICO 14302M001	-2,2	2	10,4
ANKR 20805M002	-3,2	15,5	-27,2
TRAB 20808M001	1	-12,8	63,8
BAHR 24901M002	-2,5	-3,8	4,9
RMS / COMPONENT	2,4	3,4	9,2

Table 12: Residuals in a 6-parameter fit of the minimum constrained solution to IERS ITRF 2000 epoch 2002.9. TRAB and ANKR excluded. RMS = 5.9 mm.

Station	N(mm)	E(mm)	U(mm)
NSSP	0,3	3,1	-14,3
KIT3 12334M001	3,1	2,8	5,4
ZECK 12351M001	-1,3	-0,7	-4,4
GLSV 12356M001	2,7	-1,4	7,1
NICO 14302M001	-2,2	0,7	5,2
ANKR 20805M002	-2,8	14,6	-31,1
TRAB 20808M001	0,9	-13,3	62,4
BAHR 24901M002	-3	-4,2	3,4
RMS / COMPONENT	2,5	2,8	8,3

When comparing table 11 and 12, we see that solving for rotations does not improve the fit. This means that we do not have any orientation errors.

6.5 Comparison between the minimum constrained and the constrained solution

Resulting co-ordinates from the minimum constrained solution fitted by a 3-parameter transformation to the IERS ITRF 2000 epoch 2002.9 co-ordinates and resulting co-ordinates from the constrained solution can be found in appendix 6 and 7. TRAB and ANKR were not used as fitting points or constrained.

The differences between the two solutions are found in table 13. NSSP has the largest differences. The reason is that this station was constrained in the constrained solution and therefore got the known ITRF-co-ordinates. The differences for NSSP corresponds to the residuals in table 12.

Table 13: Constrained solution minus minimum constrained solution (TRAB and ANKR not used). Unit: mm.

Stn	dN	dE	dU
NSSP	0	2	-14
AMAS	0	1	-4
KAPA	0	1	-4
NOYE	0	1	-4
VARD	0	1	-4

6.6 Analysis of alternative solutions

Besides the final solution based on 10°cut-off, elevation dependent weighting and dry-Niell mapping function, also solutions with 15° and 25° cut-off were computed – se section 5.1.

6.6.1 15°-solution

The alternative 15°-solution with Saastamoinen apriori troposphere model is set-up according to the old standard solution used in e.g. EPN.

The daily repeatability for the 15°-solution is found in appendix 8. The result is similar to the repeatability for the 10°-solution (for some stations the RMS is higher and for some lower). Generally the 10°-solution (with elevation dependent weighting) has a better repeatability than the 15°-solution. The Translation and Helmert-fit to the IERS ITRF 2000 epoch 2002.9 co-ordinates are slightly better, but the differences are small – see appendix 9. One reason for the slightly better agreement could be that the parameter setting for this solution is more similar to the GPS solutions contributing to IERS ITRF 2000.

Differences between the 10°- and 15°-constrained solutions are found in table 14. The horizontal components are almost identical but in height there are differences up to 15 mm.

From the above comparisons and tests it is not obvious which solution is the best. The differences are also quite small so its does not matter very much which solution is chosen. The choice for the final solution fell on the 10°-solution since this is recommended strategy today.

Table 14: 15°-constrained solution minus 10°-constrained solution (=final solution).

Station	dN (mm)	dE (mm)	dU (mm)
NSSP	0	1	0
AMAS	0	1	-5
KAPA	-1	0	-15
NOYE	0	-1	-4
VARD	0	0	-15

6.6.2 25°-solution

This solution was computed as a test to see if there is a large elevation dependency at some station. A large difference between 15° and 25°cut-off is an indication that the

antenna model used is not modelling the antenna (and its environment) in a good way, which might lead to errors in the height component when troposphere parameters are estimated. The differences between the 15° and 25°-solutions are shown in table 15.

Table 14: 25°- solution minus 15°- solution, daily differences. Unit: mm.

Station		330	331	332	333	334
VARD	N	0	2	0	1	1
	E	1	0	0	1	1
	U	37	49	38	42	39
NOYE	N	-1	1	0	1	0
	E	3	1	1	2	2
	U	20	25	20	25	19
KAPA	N	-1	3	0	1	0
	E	1	0	0	1	1
	U	53	57	41	32	39
AMAS	N	-1	1	1	1	1
	E	1	1	0	1	1
	U	20	31	14	19	14
NSSP	N	0	2	1	1	0
	E	0	-1	-2	0	-1
	U	10	22	7	8	6
KIT3	N	-1	3	1	-1	0
	E	3	-5	1	1	1
	U	7	43	31	27	15
ZECK	N	0	0	0	0	0
	E	0	0	0	0	0
	U	0	0	0	0	0
GLSV	N	1	0	-2	0	0
	E	0	4	0	1	-1
	U	-9	3	-13	-6	-5
NICO	N	-1	4	0	1	0
	E	1	3	1	1	0
	U	-5	7	-4	-8	-6
ANKR	N	-1	9	1	2	1
	E	3	-1	0	2	3
	U	-27	-24	-34	-28	-34
TRAB	N	-1	3	1	1	1
	E	1	4	1	1	1
	U	-7	5	-6	-5	-8
BAHR	N	-1	2	0	0	0
	E	2	2	1	1	1
	U	-16	-15	-22	-27	-24

The differences look normal in general. The differences at KAPA and VARD indicate that the antenna model/environment at these stations is not perfect. This elevation dependency can also be seen in table 14.

6.7 Conversion to ETRS 89

Armenia is situated in an area with tectonic faults between the Eurasian plate and the Anatolian plate. According to a study made by McClusky et al (2000), based on GPS-data from 1988-1997, the Armenian region seems to be more concordant with the Eurasian plate than the Anatolian. NSSP was included in the study and had an estimated velocity of 8.1 mm/year to the north and 3.6 mm/year to east in relation to the stable part of the Euroasian plate. The Anatolian plate has velocities of about 20 mm.

The conversion to ETRS 89 was performed according to the guidelines in "Specifications for reference frame fixing in the analysis of a EUREF GPS campaign" version 5.0 (2001-12-04) by C. Boucher and Z. Altamimi. The last step, which is to take the velocities within the European plate into account, has not been performed, which means that we ended up with a realisation of ETRS 89 in the epoch of the campaign (2002.9). The following model and parameters were used for the conversion:

$$X_E(2002.9) = X_{00}(2002.9) + \begin{bmatrix} T\,1_{00} \\ T\,2_{00} \\ T\,3_{00} \end{bmatrix} + \begin{bmatrix} 0 & -\dot{R}\,3_{00} & \dot{R}\,2_{00} \\ \dot{R}\,3_{00} & 0 & -\dot{R}\,1_{00} \\ -\dot{R}\,2_{00} & \dot{R}\,1_{00} & 0 \end{bmatrix} \cdot X_{00}(2002.9) \cdot (2002.9 - 1989.0)$$

$X_E(2002.9)$ = Coordinates in ETRS 89 at epoch 2002.9

$X_{00}(2002.9)$ = Coordinates in ITRF 2000 at epoch 2002.9

$T\,1_{00} = 5.4\,\text{cm}$

$T\,2_{00} = 5.1\,\text{cm}$

$T\,3_{00} = -4.8\,\text{cm}$

$\dot{R}\,1_{00} = 0.000081"/\text{Y}$

$\dot{R}\,2_{00} = 0.000490"/\text{Y}$

$\dot{R}\,3_{00} = -0.000792"/\text{Y}$

6.8 Final co-ordinates for the Armenian Zero Order stations

The constrained solution (ANKR and TRAB not constrained), based on 10 degrees elevation cut-off angle, elevation dependent weighting and Dry-Niell mapping function for the troposphere, is chosen as the final solution. Final co-ordinates in ITRF 2000 epoch 2002.9 for the Armenian stations are found in table 15. Final co-ordinates in ETRS 89 epoch 2002.9 for the Armenian stations are found in table 16.

The final horizontal co-ordinates could be considered to be on the 1 cm-level (95%) at the epoch of the observations. The vertical accuracy is estimated to 2-3 cm (95%).

Latitude, longitude and ellipsoidal heights have been computed using the GRS 1980 ellipsoid (a = 6 378 137 m f = (a-b)/a = 1/298.257222101).

Example: X = -1775821.2466, Y = 3881800.9549, Z = 4724155.4626
Example: φ = 48° 5‘ 26”173249, λ = 114° 34’ 58”228695, h = 730.9989

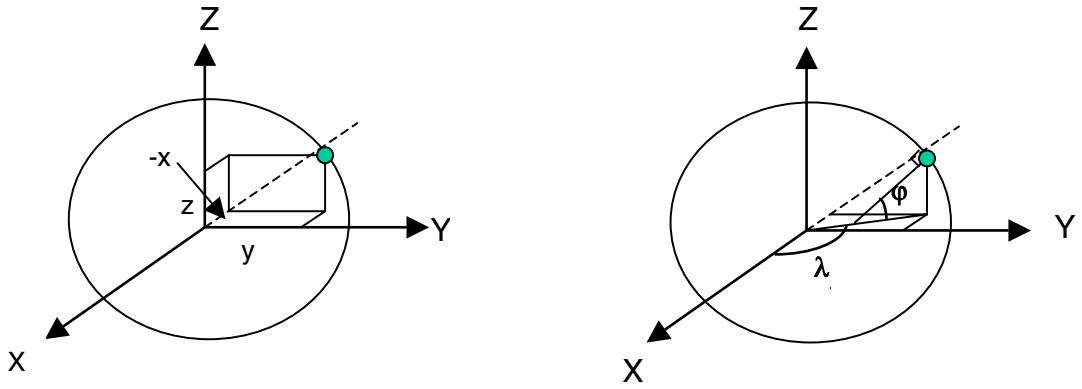

Figure 9: Geocentric Cartesian co-ordinates and geodetic co-ordinates.

Table 15: Final co-ordinates. ITRF 2000 epoch 2002.9. Heights above ellipsoid.

Station	X	Y	Z	Latitude	Longitude	Height
NSSP	3478646.6975	3418805.8208	4097987.2159	40 13 35.237171	44 30 10.533942	1194.7610
AMAS	3484623.1853	3331342.0086	4165484.7762	41 1 9.714976	43 42 42.185241	2192.1535
KAPA	3410609.3954	3587102.0703	4010241.1121	39 12 9.657378	46 26 41.202039	731.5358
NOYE	3400873.7130	3399050.8323	4177960.8050	41 10 41.999775	44 59 4.705839	927.8347
VARD	3407717.4880	3496826.7933	4093065.7958	40 9 43.821976	45 44 21.883604	2019.4095

Table 16: Final co-ordinates. ETRS 89 epoch 2002.9. Heights above ellipsoid.

Station	X	Y	Z	Latitude	Longitude	Height
NSSP	3478647.0694	3418805.6637	4097987.0717	40 13 35.230355	44 30 10.518180	1194.7863
AMAS	3484623.5548	3331341.8508	4165484.6313	41 1 9.708072	43 42 42.169436	2192.1776
KAPA	3410609.7734	3587101.9173	4010240.9710	39 12 9.650768	46 26 41.186230	731.5626
NOYE	3400874.0865	3399050.6789	4177960.6632	41 10 41.992993	44 59 4.689858	927.8586
VARD	3407717.8639	3496826.6400	4093065.6543	40 9 43.815282	45 44 21.867712	2019.4349

7 References

Astronomical Institute, University of Berne 2001: Bernese GPS Software version 4.2.

McClusky et al 2000: Global Positioning System constraints on plate kinematics and dynamics in the eastern Mediterranean and Caucasus. Journal of Geophysical Research, vol 1054, NO.B3, Pages 5695-5719. March 10, 2000.

Boucher C, Altamimi Z. 2001: Specifications for Reference Frame Fixing in the Analysis of a EUREF GPS Campaign.

Appendix 1:Antenna Phase Centre Corrections

Exctraction from PHAS_MIX.ARM containing antenna phase centre corrections for the antennas used in the campaign.

```
AOA SNR-8000 ACT           0 999999   1    0.0000  0.0000  0.1100   0
AOAD/M_T                              2    0.0000  0.0000  0.1280

ASHTECH Z-XII3             0 999999   1    0.0000  0.0000  0.1100   0
ASH700936B_M                          2    0.0000  0.0000  0.1280

ASHTECH Z-XII3             0 999999   1    0.0000  0.0000  0.1100   0
ASH700936D_M                          2    0.0000  0.0000  0.1280

TRIMBLE 4000SSI            0 999999   1    0.0000  0.0000  0.1100   0
TRM29659.00                           2    0.0000  0.0000  0.1280

LEICA SR399                0 999999   1    0.0022 -0.0003  0.0567   2
LEIAT202-GP                           2   -0.0002  0.0017  0.0536

LEICA SR520                0 999999   1    0.0003  0.0020  0.0618   2
LEIAT502                              2   -0.0014  0.0018  0.0654      NGS


FORMAT INDICATOR:
  FMT=0 :  ONLY PHASE CENTER OFFSETS ARE USED
  FMT=1 :  ZENITH DEPENDENT CORRECTIONS GIVEN TO THE RIGHT OF THE OFFSET
           VALUES ARE USED
  FMT=2 :  PHASE CENTER MAPS OR SPHERICAL HARMONICS ARE USED (ZENITH/AZIMUTH
           DEPENDENT)

ANTENNA PHASE CENTER OFFSETS MEASURED FROM ANTENNA REFERENCE POINT (ARP)
TO THE MEAN L1/L2 PHASE CENTER IN MM.

RECEIVER TYPE        ANTENNA TYPE         FROM   TO      TYP   D(Z) D(A)
******************** ******************** ****** ******  ***    ***  ***

LEICA SR520          LEIAT502                  0 999999    1      5  360


    A\Z     0      5     10     15     20     25     30     35     40     45     50
55     60     65     70     75     80     85     90

L1   0    .0    1.5    2.9    4.2    5.3    6.4    7.4    8.2    8.8    9.1    9.1
8.9    8.3    7.1    5.5    3.3     .3     .0     .0

L2   0    .0   -1.2   -1.5   -1.3    -.6     .3    1.1    2.0    2.6    2.9    2.8
2.4    1.6     .5   -1.1   -2.7   -4.6     .0     .0


RECEIVER TYPE        ANTENNA TYPE         FROM   TO      TYP   D(Z) D(A)
******************** ******************** ****** ******  ***    ***  ***

LEICA SR399          LEIAT202-GP               0 999999    1      5  360


    A\Z     0      5     10     15     20     25     30     35     40     45     50
55     60     65     70     75     80     85     90

L1   0    .0     .0     .7    2.1    3.6    5.3    6.8    8.0    8.8    9.0    8.7
7.8    6.2    4.0    1.2   -2.0   -5.5     .0     .0

L2   0    .0   -1.1   -1.5   -1.5   -1.1    -.6     .0     .5     .9    1.0     .9
.5    -.1   -1.0   -2.2   -3.5   -4.8     .0     .0
```

Appendix 2:Results from Session Processing

```
-----------------------------------------------
CAMPAIGN:       ARMENIA0
YEAR:           2002
SESSION:        3300
-----------------------------------------------

 STATION             ANT. H. (ARP)  REC. (TRANSLATED)  ANT. (TRANSLATED)

 AMAS                0.1952         LEICA SR520        LEIAT502
 ANKR 20805M002      0.0600         AOA SNR-8000 ACT   AOAD/M_T
 BAHR 24901M002      3.1220         ASHTECH Z-XII3     ASH700936B_M
 GLSV 12356M001      0.0000         TRIMBLE 4000SSI    TRM29659.00
 KAPA                0.1962         LEICA SR520        LEIAT502
 KIT3 12334M001      0.0460         AOA SNR-8000 ACT   AOAD/M_T
 NICO 14302M001      0.0500         AOA SNR-8000 ACT   AOAD/M_T
 NOYE                0.1982         LEICA SR520        LEIAT502
 NSSP                0.0827         LEICA SR520        LEIAT502
 TRAB 20808M001      0.0610         ASHTECH Z-XII3     ASH700936D_M
 VARD                0.1982         LEICA SR520        LEIAT502
 ZECK 12351M001      0.0450         AOA SNR-8000 ACT   AOAD/M_T
  ORBGEN.L01      # Sat.:  28 , # Eclipsing  4 , Max. Rms.: 53.93 for sat.: 25
  (DOY: 330)      Eclips. Sat. :    3   6   7  31
                  Min in eclips:   50  53  52  52
                  Rms          :    2   1   2   2

 CODSPP EXTRACTION
 -----------------
  12 FILES, MAX. RMS:   26.02 M FOR STATION: ZECK 12351M001
            MAX. BAD:   13.57 % FOR STATION: ANKR 20805M002

 SUMMARY OF THE MAUPRP OUTPUT FILE
 *********************************

 SESS FIL OK?  ST1  ST2 L(KM) #OBS.  RMS    DX     DY     DZ    #SL #DL #MA  MAXL3       MIN. SLIP
 ------------------------------------------------------------------------------------------------
 3300   1 OK   NSSP AMAS  111 15569 0.008-0.051-0.024-0.026   0  61  20  0.000              0
 3300   2 OK   NSSP ANKR 1001 15206 0.006-0.050-0.029-0.037   1  43  12  0.002       12302086
 3300   3 OK   NSSP BAHR 1650 14726 0.008-0.147-0.106-0.152   1 113  14  0.006       13922681
 3300   4 OK   NSSP GLSV 1565 14657 0.009-0.136-0.107-0.102  27 160  30  0.028            103
 3300   5 OK   NSSP KAPA  202 14893 0.009-0.018 0.028 0.011   0 181  37  0.000              0
 3300   6 OK   NSSP KIT3 1912 12650 0.008-0.116-0.120-0.127  25 405  22  0.026          16028
 3300   7 OK   NSSP NICO 1128 14575 0.007-0.077-0.034-0.094  81 122  20  0.030             72
 3300   8 OK   NSSP NOYE  113 15626 0.007 0.005 0.015 0.033   1  33  16  0.018             99
 3300   9 OK   NSSP TRAB  409 15426 0.008-0.013 0.015 0.014   2  13  14  0.009             72
 3300  10 OK   NSSP VARD  106 15102 0.010-0.043-0.031-0.034   5 115  28  0.019             11
 3300  11 OK   NSSP ZECK  464 15507 0.008-0.015 0.013 0.046  15  77  18  0.027          95972
 ------------------------------------------------------------------------------
 Tot:  11                787 14903 0.008                    14 120  21
 BASELINE  SESS    1    2    3    4    5    6    7    8    9   10   11   13   14   15   17   18
20   22   23   24   26   27   28   29   30   31  TOT
 ------------------------------------------------------------------------------------------------
-------------------------------------------------------
 NSSP-AMAS 3300  1.3  1.1  1.3  1.2  1.2  1.1  1.2  1.1  1.2  1.2  1.4  1.1  1.3  1.2  1.1  1.3
1.1  1.1  1.1  1.2  1.2  1.1  1.2  1.3  1.2  1.3  1.2
 NSSP-ANKR 3300  0.8  0.8  1.2  0.9  0.9  1.0  1.0  0.9  0.8  1.1  1.0  0.8  1.0  0.9  0.9  1.1
0.7  0.9  0.9  0.9  1.0  0.9  0.8  0.9  1.1  1.2  0.9
 NSSP-BAHR 3300  1.1  1.1  1.4  1.2  1.1  1.2  1.2  1.1  1.2  1.2  0.9  1.1  1.1  1.1  1.1  1.3
1.0  0.9  1.0  1.0  1.1  1.1  1.0  1.0  1.0  1.3  1.1
 NSSP-GLSV 3300  0.9  1.1  1.6  1.1  1.0  1.0  1.0  1.0  0.9  1.1  1.1  0.9  1.4  1.0  1.0  1.3
0.9  1.0  0.9  1.0  1.0  0.9  0.9  1.0  1.0  1.4  1.1
 NSSP-KAPA 3300  1.3  1.5  1.2  1.6  1.5  1.4  1.4  1.4  1.5  1.6  1.3  1.4  1.2  1.4  1.4  1.4
1.3  1.6  1.5  1.5  1.5  1.4  1.4  1.5  1.5  1.5  1.4
 NSSP-KIT3 3300  1.2  1.3  1.6  1.1  1.0  1.7  1.2  1.3  1.0  1.2  1.1  1.3  1.3  1.5  1.3  1.5
1.1  1.2  1.1  1.1  1.3  1.4  1.1  1.3  1.0  1.4  1.3
 NSSP-NICO 3300  0.9  0.9  1.2  0.9  0.9  1.1  1.0  0.9  0.9  1.0  1.0  0.8  1.2  1.0  0.9  1.1
0.9  0.9  1.0  1.0  1.0  1.0  0.9  0.9  0.9  1.1  1.0
 NSSP-NOYE 3300  1.1  1.1  1.0  1.1  1.1  1.1  1.2  1.2  1.0  1.2  1.0  1.1  1.1  1.0  1.0  1.0
1.0  1.0  1.2  1.0  1.1  1.1  1.1  1.2  1.1  1.2  1.1
 NSSP-TRAB 3300  1.0  1.1  1.0  1.2  1.1  1.1  1.2  1.1  1.0  1.1  1.2  1.0  1.2  1.1  1.1  1.2
1.1  1.1  1.0  1.1  1.1  1.0  1.0  1.0  1.1  1.2  1.1
```

```
 NSSP-VARD 3300  1.1  1.1  1.2  1.3  1.2  1.2  1.1  1.1  1.2  1.3  1.2  1.2  1.2  1.3  1.2  1.2
1.1  1.1  1.1  1.2  1.3  1.1  1.1  1.3  1.2  1.3  1.2
 NSSP-ZECK 3300  0.8  0.9  0.9  0.9  0.9  0.9  1.0  0.9  0.8  1.0  0.9  0.8  0.9  0.8  0.8  1.0
0.8  0.9  0.8  0.9  1.0  0.9  0.8  1.0  0.9  1.0  0.9
 ------------------------------------------------------------------------------------------------
------------------------------------------------
 TOTAL RMS:      1.1  1.1  1.3  1.1  1.1  1.2  1.1  1.1  1.1  1.2  1.1  1.1  1.2  1.1  1.1  1.2
1.0  1.1  1.1  1.1  1.1  1.1  1.0  1.2  1.1  1.3  1.1
 ------------------------------------------------------------------------------------------------
------------------------------------------------
 TOTAL OBS:      4.2  4.2  3.3  4.1  3.8  4.1  3.4  4.1  3.2  4.3  3.0  4.1  3.2  4.1  4.1  3.6
3.7  4.3  4.0  3.6  4.0  4.2  3.9  3.8  3.5  4.1
```

File	Length (km)	#Amb	RMS0 (mm)	Max/RMS L5 Amb (L5 Cycles)		Max/RMS L3 Amb (L3 Cycles)		#Amb	RMS0 (mm)	#Amb Res (%)
NSAM3300	110.6	90	1.2	0.109	0.026	0.085	0.029	10	1.3	88.9
NSAN3300	1001.2	74	1.1	0.479	0.160	0.093	0.028	4	1.2	94.6
NSBA3300	1649.9	78	1.3	0.491	0.189	0.098	0.044	14	1.5	82.1
NSGL3300	1564.8	102	1.1	0.496	0.157	0.092	0.031	14	1.3	86.3
NSKA3300	201.6	100	1.4	0.264	0.047	0.094	0.036	28	1.5	72.0
NSKI3300	1912.0	82	1.2	0.496	0.195	0.100	0.029	18	1.4	78.0
NSNI3300	1128.0	88	1.2	0.447	0.152	0.090	0.031	18	1.3	79.5
NSNO3300	113.3	80	1.2	0.104	0.029	0.096	0.026	6	1.2	92.5
NSTR3300	409.0	78	1.1	0.497	0.098	0.097	0.032	4	1.3	94.9
NSVA3300	105.6	100	1.2	0.161	0.037	0.097	0.034	18	1.4	82.0
NSZE3300	464.4	82	1.0	0.463	0.096	0.098	0.040	12	1.3	85.4
Tot: 11	787.3	954	1.2	0.497	0.122	0.100	0.033	146	1.3	84.7

```
 GPSEST.L01      Rms:  1.1 , # fil.:  11 , # obs.:  27376 , # par.:   787
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

 GPSEST.L02      Rms:  1.1 , # fil.:  11 , # obs.:  27007 , # par.:   786
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

 GPSEST.L03      Rms: 36.8 , # fil.:  11 , # obs.:  27007 , # par.:   515
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

 GPSEST.L04      Rms:  2.2 , # fil.:  11 , # obs.:  26113 , # par.:   385
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

 GPSEST.L05      Rms:  1.2 , # fil.:  11 , # obs.:  27007 , # par.:   399
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

 GPSEST.L06      Rms:  3.7 , # fil.:  11 , # obs.:  26113 , # par.:    97
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

 GPSEST.L07      Rms:  1.7 , # fil.:  11 , # obs.:  18856 , # par.:   354
 (DOY: 330)              Max. correction in a:   0.00 +- 0.00 for sat.:  0
```

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-----------------------------------------------
CAMPAIGN:       ARMENIA0
YEAR:           2002
SESSION:        3310
-----------------------------------------------

 STATION             ANT. H. (ARP)  REC. (TRANSLATED)  ANT. (TRANSLATED)

 AMAS                0.1952         LEICA SR520        LEIAT502
 ANKR 20805M002      0.0600         AOA SNR-8000 ACT   AOAD/M_T
 BAHR 24901M002      3.1220         ASHTECH Z-XII3     ASH700936B_M
 GLSV 12356M001      0.0000         TRIMBLE 4000SSI    TRM29659.00
 KAPA                0.1962         LEICA SR520        LEIAT502
 KIT3 12334M001      0.0460         AOA SNR-8000 ACT   AOAD/M_T
 NICO 14302M001      0.0500         AOA SNR-8000 ACT   AOAD/M_T
 NOYE                0.1982         LEICA SR520        LEIAT502
 NSSP                0.0827         LEICA SR520        LEIAT502
 TRAB 20808M001      0.0610         ASHTECH Z-XII3     ASH700936D_M
 VARD                0.1982         LEICA SR520        LEIAT502
 ZECK 12351M001      0.0450         AOA SNR-8000 ACT   AOAD/M_T
  ORBGEN.L01      # Sat.:  27 , # Eclipsing  4 , Max. Rms.:  0.02 for sat.:  1
  (DOY: 331)      Eclips. Sat. :    3   6   7  31
                  Min in eclips:   48  52  50  50
                  Rms          :    2   1   2   2

 CODSPP EXTRACTION
 -----------------
  12 FILES, MAX. RMS:   25.70 M FOR STATION: ZECK 12351M001
            MAX. BAD:   13.15 % FOR STATION: ANKR 20805M002

 SUMMARY OF THE MAUPRP OUTPUT FILE
 *********************************

 SESS FIL OK?  ST1  ST2 L(KM) #OBS.  RMS   DX    DY    DZ   #SL #DL #MA  MAXL3      MIN. SLIP
 ------------------------------------------------------------------------------------------------
 3310   1 OK   NSSP AMAS  111 15611 0.008-0.034-0.025-0.025   1  61  22  0.000             56
 3310   2 OK   NSSP ANKR 1001 15181 0.006-0.077-0.051-0.072   0  43  15  0.000              0
 3310   3 OK   NSSP BAHR 1650 14598 0.008-0.178-0.146-0.189   0  95  15  0.000              0
 3310   4 OK   NSSP GLSV 1565 14746 0.009-0.058-0.043-0.017  27 165  30  0.008       18271773
 3310   5 OK   NSSP KAPA  202 14728 0.009-0.032-0.002-0.017   1 217  42  0.006             60
 3310   6 OK   NSSP KIT3 1912 11961 0.008-0.023-0.016-0.028  16 390  27  0.030           4137
 3310   7 OK   NSSP NICO 1128 14520 0.008-0.059-0.021-0.080  85 123  22  0.028             38
 3310   8 OK   NSSP NOYE  113 15590 0.008 0.000 0.012 0.021   0  32  19  0.000              0
 3310   9 OK   NSSP TRAB  409 15466 0.008-0.015-0.007 0.001 125  18  17  0.021        1227600
 3310  10 OK   NSSP VARD  106 15264 0.010-0.035-0.027-0.028   2  89  27  0.004             58
 3310  11 OK   NSSP ZECK  464 15373 0.008-0.059-0.050-0.032  15  78  17  0.029         142585
 ------------------------------------------------------------------------------------------------
 Tot:  11                 787 14822 0.008                    25 119  23
 BASELINE  SESS    1    2    3    4    5    6    7    8    9   10   11   13   14   15   17   18
20   22   23   24   25   26   27   28   29   30   31  TOT
 ------------------------------------------------------------------------------------------------
-------------------------------------------------------------
 NSSP-AMAS 3310  1.1  1.1  1.2  1.1  1.1  1.1  1.1  1.1  1.2  1.3  1.2  1.1  1.2  1.2  1.2  1.3
1.0  1.2  1.2  1.2  1.3  1.2  1.2  1.1  1.2  1.1  1.4  1.2
 NSSP-ANKR 3310  0.8  0.8  1.2  0.8  0.9  0.9  0.9  0.8  0.8  1.0  1.0  0.7  1.1  0.9  0.8  0.9
0.9  0.9  0.8  0.9  0.9  0.9  0.8  0.8  0.9  0.9  1.2  0.9
 NSSP-BAHR 3310  1.0  1.1  1.1  1.0  1.1  1.1  1.1  1.0  1.2  1.2  0.8  1.0  1.0  1.1  1.1  1.2
0.9  0.9  1.0  1.0  0.9  1.1  0.9  1.0  1.1  1.1  1.0  1.1
 NSSP-GLSV 3310  1.0  1.0  1.6  1.0  1.0  1.0  0.9  1.0  1.0  1.1  1.2  1.0  1.3  1.0  1.0  1.4
1.0  1.1  0.9  1.0  1.0  0.9  0.9  0.9  1.0  1.0  1.3  1.1
 NSSP-KAPA 3310  1.5  1.6  1.3  1.5  1.4  1.5  1.3  1.5  1.4  1.6  1.2  1.4  1.5  1.4  1.4  1.6
1.3  1.5  1.5  1.5  1.3  1.5  1.4  1.4  1.5  1.5  1.5  1.5
 NSSP-KIT3 3310  1.2  1.3  1.7  1.1  1.1  1.9  1.1  1.2  1.1  1.3  1.1  1.2  1.3  1.5  1.4  1.5
1.1  1.2  1.3  1.1  1.2  1.3  1.2  1.1  1.3  1.1  1.5  1.3
 NSSP-NICO 3310  0.8  0.9  1.3  1.0  1.0  1.0  1.0  0.9  1.0  1.1  0.9  0.8  1.2  1.0  0.9  1.1
0.9  0.9  0.9  0.9  0.9  1.0  0.9  1.0  1.0  0.9  1.2  1.0
 NSSP-NOYE 3310  1.1  1.0  1.1  1.0  1.1  1.0  1.2  1.1  1.1  1.2  1.1  1.0  1.2  1.1  1.1  1.1
1.0  1.0  1.1  1.1  1.2  1.1  1.1  1.1  1.2  1.1  1.3  1.1
 NSSP-TRAB 3310  1.0  1.0  1.0  1.1  1.1  1.0  1.0  1.0  1.0  1.2  1.0  1.0  1.2  1.0  1.0  1.2
1.1  1.1  1.0  1.1  1.1  1.0  1.0  0.9  1.0  1.1  1.2  1.1
 NSSP-VARD 3310  1.3  1.4  1.1  1.3  1.1  1.1  1.2  1.2  1.2  1.3  1.0  1.3  1.2  1.1  1.1  1.1
1.3  1.2  1.3  1.1  1.1  1.2  1.2  1.1  1.3  1.2  1.3  1.2
 NSSP-ZECK 3310  0.8  0.9  1.0  0.9  0.8  0.9  0.9  0.9  0.9  1.0  1.0  0.8  1.0  0.9  0.9  1.0
0.8  0.9  0.9  0.8  1.0  0.9  0.8  0.9  1.0  0.9  1.1  0.9
```

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 ------------------------------------------------------------------------------------------------------------
-------------------------------------------------------
 TOTAL RMS:      1.1  1.1  1.2  1.1  1.1  1.2  1.1  1.1  1.1  1.2  1.1  1.0  1.2  1.1  1.1  1.2
1.0  1.1  1.1  1.1  1.1  1.1  1.1  1.0  1.1  1.1  1.3  1.1
 ------------------------------------------------------------------------------------------------------------
-------------------------------------------------------
 TOTAL OBS:      3.6  3.8  3.4  3.9  3.9  4.2  3.5  4.1  3.2  4.3  2.5  3.4  3.2  4.2  4.2  3.6
3.1  3.7  4.1  3.6  3.0  4.1  4.2  3.9  3.8  3.5  4.1

 File       Length   #Amb  RMS0   Max/RMS L5 Amb  Max/RMS L3 Amb   #Amb  RMS0   #Amb Res
            (km)           (mm)   (L5 Cycles)     (L3 Cycles)            (mm)   (%)
 ------------------------------------------------------------------------------------------
 NSAM3310    110.6     96   1.1    0.365  0.054    0.094  0.032      16   1.3    83.3
 NSAN3310   1001.2     80   1.0    0.309  0.103    0.097  0.033       8   1.2    90.0
 NSBA3310   1649.9     78   1.2    0.484  0.203    0.095  0.038      14   1.4    82.1
 NSGL3310   1564.8    108   1.1    0.488  0.167    0.097  0.033      12   1.3    88.9
 NSKA3310    201.6    114   1.4    0.227  0.060    0.098  0.038      44   1.6    61.4
 NSKI3310   1912.0     88   1.2    0.440  0.179    0.098  0.036      24   1.4    72.7
 NSNI3310   1128.0     92   1.1    0.480  0.142    0.099  0.034      22   1.3    76.1
 NSNO3310    113.3     88   1.1    0.118  0.028    0.098  0.030      12   1.2    86.4
 NSTR3310    409.0     84   1.1    0.291  0.083    0.100  0.034       8   1.3    90.5
 NSVA3310    105.6     96   1.2    0.328  0.052    0.097  0.033      18   1.4    81.3
 NSZE3310    464.4     86   1.0    0.436  0.104    0.098  0.037      14   1.2    83.7
 ------------------------------------------------------------------------------------------
 Tot:  11    787.3   1010   1.1    0.488  0.119    0.100  0.034     192   1.3    81.0

  GPSEST.L01      Rms:  1.1 , # fil.:  11 , # obs.:  27236 , # par.:   817
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L02      Rms:  1.1 , # fil.:  11 , # obs.:  26877 , # par.:   803
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L03      Rms: 37.8 , # fil.:  11 , # obs.:  26877 , # par.:   543
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L04      Rms:  2.1 , # fil.:  11 , # obs.:  26024 , # par.:   396
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L05      Rms:  1.1 , # fil.:  11 , # obs.:  26877 , # par.:   410
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L06      Rms:  3.6 , # fil.:  11 , # obs.:  26024 , # par.:   120
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L07      Rms:  1.6 , # fil.:  11 , # obs.:  18892 , # par.:   340
  (DOY: 331)              Max. correction in a:   0.00 +- 0.00 for sat.:  0
```

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-----------------------------------------------
CAMPAIGN:       ARMENIA0
YEAR:           2002
SESSION:        3320
-----------------------------------------------

 STATION             ANT. H. (ARP)  REC. (TRANSLATED)  ANT. (TRANSLATED)

 AMAS                0.1952         LEICA SR520        LEIAT502
 ANKR 20805M002      0.0600         AOA SNR-8000 ACT   AOAD/M_T
 BAHR 24901M002      3.1220         ASHTECH Z-XII3     ASH700936B_M
 GLSV 12356M001      0.0000         TRIMBLE 4000SSI    TRM29659.00
 KAPA                0.1962         LEICA SR520        LEIAT502
 KIT3 12334M001      0.0460         AOA SNR-8000 ACT   AOAD/M_T
 NICO 14302M001      0.0500         AOA SNR-8000 ACT   AOAD/M_T
 NOYE                0.1982         LEICA SR520        LEIAT502
 NSSP                0.0827         LEICA SR520        LEIAT502
 TRAB 20808M001      0.0610         ASHTECH Z-XII3     ASH700936D_M
 VARD                0.1982         LEICA SR520        LEIAT502
 ZECK 12351M001      0.0450         AOA SNR-8000 ACT   AOAD/M_T
  ORBGEN.L01      # Sat.:  27 , # Eclipsing  4 , Max. Rms.:  0.02 for sat.:  1
  (DOY: 332)      Eclips. Sat. :    3   6   7  31
                  Min in eclips:   46  51  48  49
                  Rms          :    2   2   2   2

 CODSPP EXTRACTION
 -----------------
  12 FILES, MAX. RMS:   25.73 M FOR STATION: ZECK 12351M001
            MAX. BAD:   12.08 % FOR STATION: ANKR 20805M002

 SUMMARY OF THE MAUPRP OUTPUT FILE
 *********************************

 SESS FIL OK?  ST1  ST2 L(KM) #OBS.  RMS   DX    DY    DZ   #SL #DL #MA  MAXL3      MIN. SLIP
 ------------------------------------------------------------------------------------------------
 3320   1 OK   NSSP AMAS  111 14815 0.008-0.057-0.034-0.039   2  55  27  0.023            21
 3320   2 OK   NSSP ANKR 1001 14376 0.006-0.080-0.053-0.073   6  69  23  0.021         34838
 3320   3 OK   NSSP BAHR 1650 13782 0.008-0.124-0.115-0.137   0 144  27  0.000             0
 3320   4 OK   NSSP GLSV 1565 13857 0.009-0.037-0.054 0.001  25 164  40  0.000             0
 3320   5 OK   NSSP KAPA  202  9091 0.009-0.029-0.010-0.030   1 138  27  0.028            63
 3320   6 OK   NSSP KIT3 1912 11861 0.009 0.008-0.001 0.005  27 361  26  0.026         20890
 3320   7 OK   NSSP NICO 1128 13618 0.008-0.086-0.053-0.097  71 130  26  0.027           585
 3320   8 OK   NSSP NOYE  113 14832 0.008-0.043-0.029-0.027   2  52  29  0.006            40
 3320   9 OK   NSSP TRAB  409 14651 0.008-0.070-0.067-0.083  87  20  25  0.016      15958800
 3320  10 OK   NSSP VARD  106 14220 0.011-0.017-0.005-0.019   1 216  49  0.006            24
 3320  11 OK   NSSP ZECK  464 14668 0.008-0.082-0.056-0.057  16  76  26  0.027        121350
 ------------------------------------------------------------------------------
 Tot:  11                787 13616 0.008                    22 130  30
 BASELINE  SESS    1    2    3    4    5    6    7    8    9   10   11   13   14   15   18   20
22   23   24   25   26   27   28   29   30   31  TOT
 ------------------------------------------------------------------------------------------------
-------------------------------------------------
 NSSP-AMAS 3320  1.2  1.1  1.1  1.1  1.2  1.1  1.3  1.1  1.2  1.3  1.1  1.0  1.1  1.2  1.2  1.0
1.2  1.1  1.1  1.1  1.1  1.1  1.1  1.3  1.2  1.3  1.2
 NSSP-ANKR 3320  0.9  0.9  1.1  0.8  0.9  0.9  0.9  0.9  0.9  0.9  0.9  0.9  1.0  0.9  1.0  0.8
0.9  0.8  0.9  0.8  0.9  0.8  0.8  0.9  0.9  1.1  0.9
 NSSP-BAHR 3320  1.1  1.1  1.1  1.1  1.0  1.1  1.1  1.1  1.1  1.1  0.9  0.9  1.0  1.0  1.2  0.9
1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.1  1.1  1.0
 NSSP-GLSV 3320  0.9  1.0  1.2  1.1  1.0  1.1  1.1  1.1  0.8  1.2  0.9  1.0  1.2  1.1  1.2  0.9
1.1  1.1  1.1  0.9  1.0  1.1  1.1  1.0  1.1  1.2  1.1
 NSSP-KAPA 3320  1.3  1.5  1.5  1.4  1.5  1.4  1.5  1.7  1.4  1.7  1.2  1.5  1.5  1.4  1.5  1.3
1.4  1.7  1.7  1.3  1.5       1.4  1.7  1.4  1.3  1.5
 NSSP-KIT3 3320  1.1  1.2  1.4  1.0  1.1  1.6  1.1  1.3  1.0  1.2  1.0  1.1  1.2  1.3  1.3  1.0
1.1  1.2  1.1  0.9  1.2  1.2  1.0  1.3  1.0  1.4  1.2
 NSSP-NICO 3320  0.9  1.0  1.1  1.0  1.0  1.0  1.0  1.0  1.0  1.1  0.9  0.9  1.1  0.9  1.0  0.8
1.0  1.0  1.0  0.9  0.9  1.0  0.9  0.9  1.0  1.1  1.0
 NSSP-NOYE 3320  1.1  1.0  1.0  1.1  1.0  1.0  1.1  1.1  1.0  1.1  1.0  1.0  1.1  1.1  1.1  0.9
1.0  1.0  1.1  0.9  1.1  1.1  1.0  1.1  1.1  1.2  1.0
 NSSP-TRAB 3320  1.0  1.0  1.0  1.2  1.1  1.1  1.1  1.0  1.1  1.1  1.1  1.0  1.2  1.0  1.1  1.1
1.1  1.0  1.2  1.0  1.0  1.0  0.9  1.0  1.1  1.2  1.1
 NSSP-VARD 3320  1.2  1.2  1.2  1.4  1.3  1.3  1.3  1.1  1.3  1.3  1.2  1.1  1.3  1.3  1.4  1.2
1.3  1.2  1.2  1.3  1.3  1.2  1.1  1.3  1.4  1.4  1.3
 NSSP-ZECK 3320  0.9  0.9  0.9  0.9  0.8  0.8  1.0  0.9  0.9  0.9  0.8  0.8  0.9  0.8  1.0  0.7
0.9  0.8  0.9  0.8  0.9  0.9  0.9  1.0  0.9  1.0  0.9
```

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 ------------------------------------------------------------------------------------------------
-------------------------------------------------
 TOTAL RMS:      1.1  1.1  1.2  1.1  1.1  1.2  1.1  1.1  1.1  1.1  1.0  1.0  1.2  1.1  1.2  1.0
1.1  1.1  1.1  1.0  1.1  1.0  1.0  1.1  1.1  1.2  1.1
 ------------------------------------------------------------------------------------------------
-------------------------------------------------
 TOTAL OBS:      3.7  3.6  3.6  3.7  4.1  4.5  3.6  4.1  3.5  4.5  3.4  3.4  3.4  4.4  3.9  3.2
3.7  4.3  3.9  3.7  4.3  3.6  4.0  4.0  3.8  4.2

 File       Length   #Amb  RMS0   Max/RMS L5 Amb  Max/RMS L3 Amb   #Amb  RMS0   #Amb Res
            (km)           (mm)   (L5 Cycles)     (L3 Cycles)             (mm)   (%)
 ------------------------------------------------------------------------------------------
 NSAM3320    110.6    102   1.1    0.159  0.042    0.094  0.033      12   1.2    88.2
 NSAN3320   1001.2     94   1.0    0.444  0.162    0.093  0.030      10   1.2    89.4
 NSBA3320   1649.9    100   1.2    0.485  0.181    0.093  0.042      26   1.4    74.0
 NSGL3320   1564.8    122   1.2    0.485  0.198    0.098  0.035      30   1.4    75.4
 NSKA3320    201.6     88   1.3    0.314  0.070    0.097  0.042      24   1.5    72.7
 NSKI3320   1912.0     90   1.2    0.499  0.219    0.092  0.027      22   1.3    75.6
 NSNI3320   1128.0     98   1.2    0.492  0.184    0.095  0.030      26   1.3    73.5
 NSNO3320    113.3    104   1.0    0.181  0.040    0.099  0.031      12   1.1    88.5
 NSTR3320    409.0     98   1.1    0.436  0.103    0.092  0.028      10   1.2    89.8
 NSVA3320    105.6    138   1.2    0.173  0.038    0.099  0.037      36   1.4    73.9
 NSZE3320    464.4     98   0.9    0.368  0.116    0.100  0.037      12   1.1    87.8
 ------------------------------------------------------------------------------------------
 Tot:  11    787.3   1132   1.1    0.499  0.136    0.100  0.034     220   1.3    80.6

  GPSEST.L01      Rms:  1.1 , # fil.:  11 , # obs.:  25072 , # par.:   882
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L02      Rms:  1.1 , # fil.:  11 , # obs.:  24794 , # par.:   865
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L03      Rms: 43.6 , # fil.:  11 , # obs.:  24794 , # par.:   622
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L04      Rms:  2.1 , # fil.:  11 , # obs.:  23918 , # par.:   423
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L05      Rms:  1.1 , # fil.:  11 , # obs.:  24794 , # par.:   436
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L06      Rms:  3.5 , # fil.:  11 , # obs.:  23918 , # par.:   152
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L07      Rms:  1.7 , # fil.:  11 , # obs.:  16949 , # par.:   376
  (DOY: 332)              Max. correction in a:   0.00 +- 0.00 for sat.:  0
```

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-----------------------------------------------
CAMPAIGN:       ARMENIA0
YEAR:           2002
SESSION:        3330
-----------------------------------------------

 STATION             ANT. H. (ARP)  REC. (TRANSLATED)  ANT. (TRANSLATED)

 AMAS                0.1952         LEICA SR520        LEIAT502
 ANKR 20805M002      0.0600         AOA SNR-8000 ACT   AOAD/M_T
 BAHR 24901M002      3.1220         ASHTECH Z-XII3     ASH700936B_M
 GLSV 12356M001      0.0000         TRIMBLE 4000SSI    TRM29659.00
 KAPA                0.1962         LEICA SR520        LEIAT502
 KIT3 12334M001      0.0460         AOA SNR-8000 ACT   AOAD/M_T
 NICO 14302M001      0.0500         AOA SNR-8000 ACT   AOAD/M_T
 NOYE                0.1982         LEICA SR520        LEIAT502
 NSSP                0.0827         LEICA SR520        LEIAT502
 TRAB 20808M001      0.0610         ASHTECH Z-XII3     ASH700936D_M
 VARD                0.1982         LEICA SR520        LEIAT502
 ZECK 12351M001      0.0450         AOA SNR-8000 ACT   AOAD/M_T
  ORBGEN.L01      # Sat.:  27 , # Eclipsing  4 , Max. Rms.:  0.03 for sat.: 24
  (DOY: 333)      Eclips. Sat. :    3   6   7  31
                  Min in eclips:   44  49  46  46
                  Rms          :    2   2   2   2

 CODSPP EXTRACTION
 -----------------
  12 FILES, MAX. RMS:   26.80 M FOR STATION: ZECK 12351M001
            MAX. BAD:   10.80 % FOR STATION: GLSV 12356M001

 SUMMARY OF THE MAUPRP OUTPUT FILE
 *********************************

 SESS FIL OK?  ST1  ST2 L(KM) #OBS.  RMS   DX    DY    DZ   #SL #DL #MA  MAXL3      MIN. SLIP
 ------------------------------------------------------------------------------------------------
 3330   1 OK   NSSP AMAS  111 15370 0.008-0.024-0.011-0.016   3  45  28  0.022            40
 3330   2 OK   NSSP ANKR 1001 14943 0.006-0.027-0.014-0.019   1  80  22  0.024       1393675
 3330   3 OK   NSSP BAHR 1650 14452 0.009-0.122-0.091-0.108   1  75  23  0.018        262082
 3330   4 OK   NSSP GLSV 1565 14422 0.009 0.014-0.001 0.066  26 159  36  0.000             0
 3330   5 OK   NSSP KAPA  202 14613 0.009-0.092-0.080-0.083   3 211  43  0.008            28
 3330   6 OK   NSSP KIT3 1912 11576 0.009 0.019 0.005 0.024  34 350  42  0.030         81990
 3330   7 OK   NSSP NICO 1128 14325 0.007 0.026 0.087 0.016  97 118  23  0.027           112
 3330   8 OK   NSSP NOYE  113 15411 0.008-0.052-0.043-0.039   1  42  23  0.004            21
 3330   9 OK   NSSP TRAB  409 13149 0.008-0.166-0.177-0.180   0  19  28  0.000             0
 3330  10 OK   NSSP VARD  106 14707 0.011-0.021-0.029-0.021   2 249  51  0.026            80
 3330  11 OK   NSSP ZECK  464 15320 0.008-0.004 0.005 0.021  12  84  27  0.027        152928
 ------------------------------------------------------------------------------------------------
 Tot:  11                787 14390 0.008                     16 130  31
 BASELINE  SESS    1    2    3    4    5    6    7    8    9   10   11   13   14   15   17   18
20   22   23   24   25   26   27   28   29   30   31  TOT
 ------------------------------------------------------------------------------------------------
-------------------------------------------------------
 NSSP-AMAS 3330  1.2  1.0  1.2  1.2  1.3  1.1  1.2  1.2  1.4  1.3  1.2  1.2  1.1  1.2  1.2  1.2
1.0  1.1  1.1  1.2  1.3  1.2  1.1  1.1  1.3  1.2  1.3  1.2
 NSSP-ANKR 3330  0.9  0.8  1.0  0.9  1.0  0.9  1.0  1.0  0.8  0.9  0.9  1.0  1.0  0.9  0.9  1.0
0.8  0.9  0.9  1.0  0.9  0.9  0.9  0.9  1.0  0.9  1.1  0.9
 NSSP-BAHR 3330  1.0  0.9  1.0  1.0  1.1  1.0  1.1  1.0  1.0  1.1  0.9  1.1  1.0  1.0  1.0  1.1
0.9  0.8  1.0  1.2  0.9  1.1  0.9  1.0  1.0  1.0  1.0  1.0
 NSSP-GLSV 3330  0.9  1.0  1.2  1.0  0.9  1.0  1.0  1.0  0.8  1.1  0.9  1.0  1.2  1.0  1.0  1.1
0.9  1.0  1.0  1.0  1.0  1.0  1.1  1.0  1.0  1.0  1.1  1.0
 NSSP-KAPA 3330  1.4  1.5  1.3  1.6  1.5  1.5  1.4  1.5  1.5  1.5  1.1  1.6  1.4  1.3  1.4  1.5
1.2  1.3  1.5  1.5  1.4  1.4  1.4  1.4  1.6  1.4  1.6  1.4
 NSSP-KIT3 3330  1.1  1.2  1.5  1.1  1.0  1.4  1.1  1.3  1.1  1.2  1.1  1.4  1.3  1.3  1.2  1.3
1.0  1.2  1.1  1.1  1.2  1.1  1.3  1.1  1.3  1.1  1.4  1.2
 NSSP-NICO 3330  1.0  1.1  1.3  1.2  1.0  1.1  1.1  1.0  1.1  1.1  1.0  1.0  1.3  1.1  1.1  1.2
0.9  1.0  1.1  1.2  1.0  1.2  1.1  1.1  1.1  1.1  1.2  1.1
 NSSP-NOYE 3330  1.1  1.1  1.0  1.1  1.1  1.1  1.2  1.2  1.1  1.2  1.0  1.2  1.1  1.2  1.1  1.1
0.9  1.1  1.2  1.2  1.1  1.1  1.3  1.1  1.2  1.2  1.3  1.1
 NSSP-TRAB 3330  1.0  1.0  0.9  1.1  1.1  1.1  1.0  1.0  0.9  1.1  1.0  1.1  1.2  1.0  1.1  1.1
0.9  1.1  1.1  1.1  1.1  1.1  1.0  0.9  1.1  1.1  1.2  1.1
 NSSP-VARD 3330  1.4  1.4  1.2  1.3  1.2  1.3  1.1  1.2  1.2  1.3  1.2  1.4  1.3  1.3  1.3  1.2
1.3  1.3  1.3  1.3  1.4  1.2  1.3  1.1  1.3  1.3  1.3  1.3
 NSSP-ZECK 3330  0.8  0.9  0.9  0.9  0.9  0.9  0.9  0.9  0.8  1.0  0.9  0.9  0.9  0.9  0.9  0.9
0.8  0.9  0.9  0.9  1.0  0.9  0.9  0.8  1.0  1.0  1.0  0.9
```

```
 ------------------------------------------------------------------------------------------------------------
-------------------------------------------------------
 TOTAL RMS:      1.1  1.1  1.1  1.1  1.1  1.1  1.1  1.1  1.1  1.2  1.0  1.2  1.2  1.1  1.1  1.2
1.0  1.1  1.1  1.2  1.1  1.1  1.1  1.1  1.2  1.1  1.2  1.1
 ------------------------------------------------------------------------------------------------------------
-------------------------------------------------------
 TOTAL OBS:      3.6  3.5  3.4  3.6  3.9  4.2  3.4  3.7  3.3  4.4  3.1  3.5  3.2  4.2  4.2  3.6
3.2  3.6  4.0  3.3  3.7  4.0  3.6  3.9  3.8  3.6  4.2

 File       Length   #Amb  RMS0   Max/RMS L5 Amb  Max/RMS L3 Amb   #Amb  RMS0   #Amb Res
            (km)           (mm)   (L5 Cycles)     (L3 Cycles)            (mm)   (%)
 ------------------------------------------------------------------------------------------
 NSAM3330    110.6    104   1.1    0.224  0.033    0.088  0.030      16   1.2    84.6
 NSAN3330   1001.2     94   1.1    0.352  0.114    0.089  0.028      14   1.2    85.1
 NSBA3330   1649.9     96   1.1    0.404  0.172    0.100  0.041      24   1.4    75.0
 NSGL3330   1564.8    120   1.2    0.430  0.131    0.095  0.033      34   1.4    71.7
 NSKA3330    201.6    120   1.4    0.408  0.068    0.094  0.037      36   1.5    70.0
 NSKI3330   1912.0    122   1.1    0.467  0.170    0.095  0.034      30   1.3    75.4
 NSNI3330   1128.0     94   1.3    0.492  0.121    0.097  0.031      18   1.4    80.9
 NSNO3330    113.3     94   1.2    0.193  0.034    0.100  0.028      10   1.3    89.4
 NSTR3330    409.0    102   1.1    0.433  0.101    0.096  0.030      18   1.2    82.4
 NSVA3330    105.6    140   1.3    0.183  0.041    0.091  0.033      54   1.4    61.4
 NSZE3330    464.4    102   1.0    0.355  0.086    0.098  0.034      20   1.2    80.4
 ------------------------------------------------------------------------------------------
 Tot:  11    787.3   1188   1.2    0.492  0.108    0.100  0.033     274   1.3    76.9

  GPSEST.L01      Rms:  1.1 , # fil.:  11 , # obs.:  26364 , # par.:   907
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L02      Rms:  1.1 , # fil.:  11 , # obs.:  25993 , # par.:   891
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L03      Rms: 35.1 , # fil.:  11 , # obs.:  25993 , # par.:   648
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L04      Rms:  2.1 , # fil.:  11 , # obs.:  25085 , # par.:   445
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L05      Rms:  1.2 , # fil.:  11 , # obs.:  25993 , # par.:   464
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L06      Rms:  3.5 , # fil.:  11 , # obs.:  25085 , # par.:   172
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L07      Rms:  1.7 , # fil.:  11 , # obs.:  18208 , # par.:   376
  (DOY: 333)              Max. correction in a:   0.00 +- 0.00 for sat.:  0
```

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------------------------------------------------
CAMPAIGN:       ARMENIA0
YEAR:           2002
SESSION:        3340
------------------------------------------------

 STATION             ANT. H. (ARP)  REC. (TRANSLATED)  ANT. (TRANSLATED)

 AMAS                0.1952         LEICA SR520        LEIAT502
 ANKR 20805M002      0.0600         AOA SNR-8000 ACT   AOAD/M_T
 BAHR 24901M002      3.1220         ASHTECH Z-XII3     ASH700936B_M
 GLSV 12356M001      0.0000         TRIMBLE 4000SSI    TRM29659.00
 KAPA                0.1962         LEICA SR520        LEIAT502
 KIT3 12334M001      0.0460         AOA SNR-8000 ACT   AOAD/M_T
 NICO 14302M001      0.0500         AOA SNR-8000 ACT   AOAD/M_T
 NOYE                0.1982         LEICA SR520        LEIAT502
 NSSP                0.0827         LEICA SR520        LEIAT502
 TRAB 20808M001      0.0610         ASHTECH Z-XII3     ASH700936D_M
 VARD                0.1982         LEICA SR520        LEIAT502
 ZECK 12351M001      0.0450         AOA SNR-8000 ACT   AOAD/M_T
  ORBGEN.L01      # Sat.:  27 , # Eclipsing  4 , Max. Rms.:  0.03 for sat.: 15
  (DOY: 334)      Eclips. Sat. :    3   6   7  31
                  Min in eclips:   40  47  43  44
                  Rms          :    2   2   2   2

 CODSPP EXTRACTION
 -----------------
  12 FILES, MAX. RMS:   26.97 M FOR STATION: ZECK 12351M001
            MAX. BAD:   13.00 % FOR STATION: ANKR 20805M002

 SUMMARY OF THE MAUPRP OUTPUT FILE
 *********************************

 SESS FIL OK?  ST1  ST2 L(KM) #OBS.  RMS   DX    DY    DZ   #SL #DL #MA  MAXL3      MIN. SLIP
 ------------------------------------------------------------------------------------------------
 3340   1 OK   NSSP AMAS  111 15610 0.008-0.019-0.004-0.011   3  51  30  0.005            20
 3340   2 OK   NSSP ANKR 1001 15090 0.006-0.022-0.020-0.028   0  67  29  0.000             0
 3340   3 OK   NSSP BAHR 1650 14634 0.008-0.076-0.053-0.070   1 109  28  0.003       1848044
 3340   4 OK   NSSP GLSV 1565 14649 0.008 0.059 0.056 0.106  27 150  34  0.017       4549769
 3340   5 OK   NSSP KAPA  202 14703 0.009-0.091-0.051-0.057   1 226  47  0.007            20
 3340   6 OK   NSSP KIT3 1912 12555 0.008 0.006-0.014-0.010  39 398  29  0.029         20626
 3340   7 OK   NSSP NICO 1128 14519 0.007 0.080 0.076 0.050  68 119  31  0.028         13678
 3340   8 OK   NSSP NOYE  113 15607 0.007-0.031-0.020-0.022   0  42  29  0.000             0
 3340   9 OK   NSSP TRAB  409 15471 0.008-0.106-0.056-0.098   0  26  27  0.000             0
 3340  10 OK   NSSP VARD  106 15082 0.011-0.034-0.012-0.022   0 257  62  0.000             0
 3340  11 OK   NSSP ZECK  464 15483 0.008-0.002 0.012 0.025   7  76  24  0.027        155222
 ------------------------------------------------------------------------------------------------
 Tot:  11                 787 14855 0.008                    13 138  34
 BASELINE  SESS    1    2    3    4    5    6    7    8    9   10   11   13   14   15   17   18
20   22   23   24   25   26   27   28   29   30   31  TOT
 ------------------------------------------------------------------------------------------------
------------------------------------------------------------
 NSSP-AMAS 3340  1.1  1.0  1.1  1.2  1.2  1.1  1.1  1.1  1.3  1.3  1.1  1.1  1.2  1.2  1.2  1.3
1.0  1.1  1.2  1.2  1.1  1.2  1.2  1.1  1.3  1.2  1.3  1.2
 NSSP-ANKR 3340  0.9  0.9  1.0  0.9  0.9  0.9  1.0  0.8  0.9  0.9  0.9  0.9  1.1  0.9  0.9  1.0
0.9  0.9  0.9  0.9  0.9  1.0  0.9  0.8  0.9  0.9  1.1  0.9
 NSSP-BAHR 3340  1.0  1.0  1.0  1.0  1.0  1.0  1.1  1.0  1.0  1.0  1.0  1.1  1.1  1.0  1.1  1.2
1.0  0.9  1.0  1.0  1.0  1.0  1.0  0.9  1.0  0.9  1.1  1.0
 NSSP-GLSV 3340  0.9  1.0  1.0  1.0  0.9  1.0  0.9  0.9  0.9  1.1  0.9  0.9  0.9  1.1  1.0  1.2
0.9  1.0  1.0  1.0  1.0  1.0  0.9  0.9  1.0  1.0  1.2  1.0
 NSSP-KAPA 3340  1.3  1.4  1.4  1.5  1.4  1.5  1.4  1.4  1.6  1.6  1.2  1.4  1.5  1.4  1.6  1.6
1.2  1.4  1.6  1.6  1.3  1.6  1.3  1.4  1.5  1.5  1.6  1.5
 NSSP-KIT3 3340  1.2  1.2  1.8  1.0  1.0  1.7  1.0  1.4  1.0  1.2  1.1  1.3  1.6  2.1  1.5  1.8
1.0  1.2  1.2  1.1  1.1  1.3  1.2  1.2  1.3  1.0  1.7  1.4
 NSSP-NICO 3340  0.9  0.9  1.2  1.0  1.1  1.0  1.0  0.9  1.0  1.0  1.0  0.9  1.3  1.1  1.1  1.2
0.8  1.0  1.0  1.0  1.1  1.0  0.9  1.0  1.0  1.0  1.2  1.0
 NSSP-NOYE 3340  1.0  1.0  1.0  1.1  1.1  1.1  1.2  1.1  1.2  1.2  1.1  1.0  1.1  1.2  1.2  1.1
1.0  1.0  1.2  1.1  1.1  1.1  1.1  1.1  1.1  1.2  1.3  1.1
 NSSP-TRAB 3340  1.0  1.0  1.0  1.1  1.2  1.1  1.0  1.0  1.0  1.2  1.1  1.1  1.2  1.1  1.2  1.2
1.1  1.1  1.1  1.2  1.1  1.1  1.0  1.0  1.1  1.1  1.2  1.1
 NSSP-VARD 3340  1.2  1.2  1.1  1.2  1.3  1.2  1.2  1.1  1.2  1.3  1.1  1.2  1.2  1.3  1.3  1.2
1.3  1.2  1.3  1.2  1.4  1.2  1.1  1.1  1.2  1.3  1.3  1.2
 NSSP-ZECK 3340  0.8  0.9  0.9  0.9  1.0  0.9  1.0  0.9  0.9  1.0  0.9  0.9  0.9  1.0  0.9  1.0
0.8  0.9  0.9  0.9  0.9  1.0  0.9  0.9  1.0  0.9  1.1  0.9
```

```
 ------------------------------------------------------------------------------------------------------------
-------------------------------------------------------
 TOTAL RMS:      1.0  1.1  1.2  1.1  1.1  1.2  1.1  1.1  1.1  1.2  1.0  1.1  1.2  1.2  1.2  1.3
1.0  1.1  1.1  1.1  1.1  1.1  1.1  1.1  1.1  1.1  1.3  1.1
 ------------------------------------------------------------------------------------------------------------
-------------------------------------------------------
 TOTAL OBS:      3.6  3.6  3.3  4.1  3.8  4.2  3.3  3.4  3.2  4.0  3.2  3.4  3.2  4.2  4.2  3.6
3.8  4.1  4.0  3.5  3.7  4.0  3.6  3.8  3.8  3.5  4.0

 File       Length   #Amb  RMS0   Max/RMS L5 Amb  Max/RMS L3 Amb   #Amb  RMS0   #Amb Res
            (km)           (mm)   (L5 Cycles)     (L3 Cycles)            (mm)   (%)
 ------------------------------------------------------------------------------------------
 NSAM3340    110.6    108   1.2    0.241  0.049    0.098  0.030      14   1.2    87.0
 NSAN3340   1001.2    106   1.0    0.493  0.144    0.097  0.031      14   1.1    86.8
 NSBA3340   1649.9    106   1.3    0.480  0.164    0.090  0.036      30   1.5    71.7
 NSGL3340   1564.8    118   1.2    0.495  0.152    0.100  0.039      24   1.4    79.7
 NSKA3340    201.6    122   1.6    0.384  0.066    0.096  0.032      40   1.7    67.2
 NSKI3340   1912.0     98   1.3    0.385  0.145    0.099  0.033      22   1.4    77.6
 NSNI3340   1128.0    112   1.3    0.494  0.159    0.098  0.030      36   1.4    67.9
 NSNO3340    113.3    106   1.2    0.253  0.042    0.098  0.032      10   1.3    90.6
 NSTR3340    409.0    104   1.1    0.491  0.113    0.099  0.035      10   1.2    90.4
 NSVA3340    105.6    164   1.3    0.132  0.034    0.087  0.027      66   1.4    59.8
 NSZE3340    464.4     96   1.0    0.460  0.110    0.094  0.039       8   1.3    91.7
 ------------------------------------------------------------------------------------------
 Tot:  11    787.3   1240   1.2    0.495  0.115    0.100  0.033     274   1.4    77.9

  GPSEST.L01      Rms:  1.1 , # fil.:  11 , # obs.:  27216 , # par.:   935
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L02      Rms:  1.1 , # fil.:  11 , # obs.:  26842 , # par.:   920
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L03      Rms: 42.4 , # fil.:  11 , # obs.:  26842 , # par.:   671
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L04      Rms:  2.2 , # fil.:  11 , # obs.:  25995 , # par.:   442
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L05      Rms:  1.2 , # fil.:  11 , # obs.:  26842 , # par.:   464
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L06      Rms:  3.5 , # fil.:  11 , # obs.:  25995 , # par.:   166
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0

  GPSEST.L07      Rms:  1.7 , # fil.:  11 , # obs.:  18872 , # par.:   373
  (DOY: 334)              Max. correction in a:   0.00 +- 0.00 for sat.:  0
```

Appendix 3: Differences between Float- and Fixed-Solutions

Differenses in mm.

Diff North	**330**	**331**	**332**	**333**	**334**	**rms**
VARD	0	0	-1	-1	0	1
NOYE	0	0	-1	0	0	0
KAPA	0	0	1	0	0	0
AMAS	1	1	0	1	1	1
NSSP	1	1	0	1	1	1
KIT3 12334M001	1	1	0	2	1	1
ZECK 12351M001	0	0	0	0	0	0
GLSV 12356M001	0	1	0	1	1	1
NICO 14302M001	-1	-1	-2	-2	-1	1
ANKR 20805M002	1	-1	-1	-1	-1	1
TRAB 20808M001	-1	0	-1	-1	-1	1
BAHR 24901M002	0	0	-1	0	0	1
rms	1	1	1	1	1	
Diff East	**330**	**331**	**332**	**333**	**334**	**rms**
VARD	-3	-2	-3	0	0	2
NOYE	-3	0	1	1	2	2
KAPA	-2	-1	5	3	0	3
AMAS	-1	0	1	3	2	2
NSSP	7	7	7	4	3	6
KIT3 12334M001	-4	-3	0	-1	2	2
ZECK 12351M001	0	0	0	0	0	0
GLSV 12356M001	-5	-7	-2	-6	-6	6
NICO 14302M001	-4	-2	0	0	-3	2
ANKR 20805M002	-1	-3	-4	1	-5	3
TRAB 20808M001	-1	-2	-1	1	-2	2
BAHR 24901M002	-2	-2	-3	0	-3	2
rms	3	4	3	3	3	
Diff Up	**330**	**331**	**332**	**333**	**334**	**rms**
VARD	3	-4	-3	-1	3	3
NOYE	3	-2	-4	-4	0	3
KAPA	2	-3	-3	-7	2	4
AMAS	-1	-4	-5	-8	1	5
NSSP	-1	-2	-3	-9	-3	5
KIT3 12334M001	-1	-4	-5	-6	-7	5
ZECK 12351M001	0	0	0	0	0	0
GLSV 12356M001	-3	-5	-6	-6	-7	5
NICO 14302M001	0	-3	-4	-4	2	3
ANKR 20805M002	0	-11	-9	-7	-6	7
TRAB 20808M001	1	-3	-4	-4	-1	3
BAHR 24901M002	-2	-5	-6	-7	-4	5
rms	2	5	5	6	4	

Appendix 4:Translations to IERS ITRF 00 epoch 2002.9

Session 330	3-parameter fit residulas		
Station	N(mm)	E(mm)	U(mm)
NSSP	1,0	4,5	-18,3
KIT3 12334M001	4,2	5,2	-8,6
ZECK 12351M001	-0,7	-1,4	-4,8
GLSV 12356M001	3,4	-2,0	2,4
NICO 14302M001	-2,8	0,9	6,2
ANKR 20805M002	-3,4	14,5	-32,9
TRAB 20808M001	0,2	-13,0	60,5
BAHR 24901M002	-3,0	-4,3	-3,8
RMS / COMPONENT	2,9	8,0	27,3

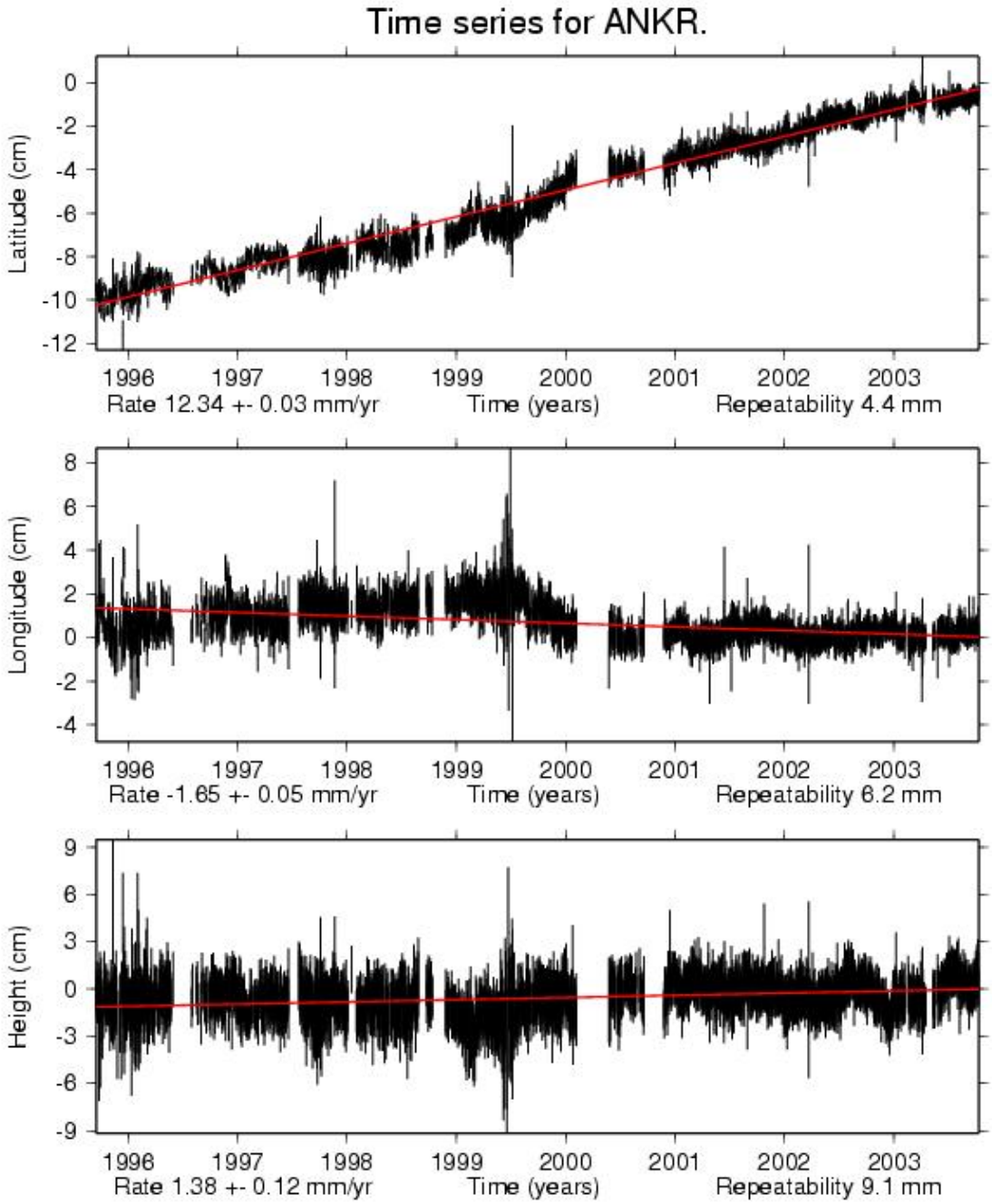
Session 331	3-parameter fit residulas		
Station	N(mm)	E(mm)	U(mm)
NSSP	0,4	4,6	-13,6
KIT3 12334M001	3,2	5,7	-8,8
ZECK 12351M001	-0,7	-1,2	-7,8
GLSV 12356M001	6,2	-3,4	-7,3
NICO 14302M001	-2,4	0,8	4,7
ANKR 20805M002	-3,0	14,0	-31,5
TRAB 20808M001	1,7	-12,9	65,4
BAHR 24901M002	-4,0	-6,0	0,5
RMS / COMPONENT	3,4	8,2	28,4

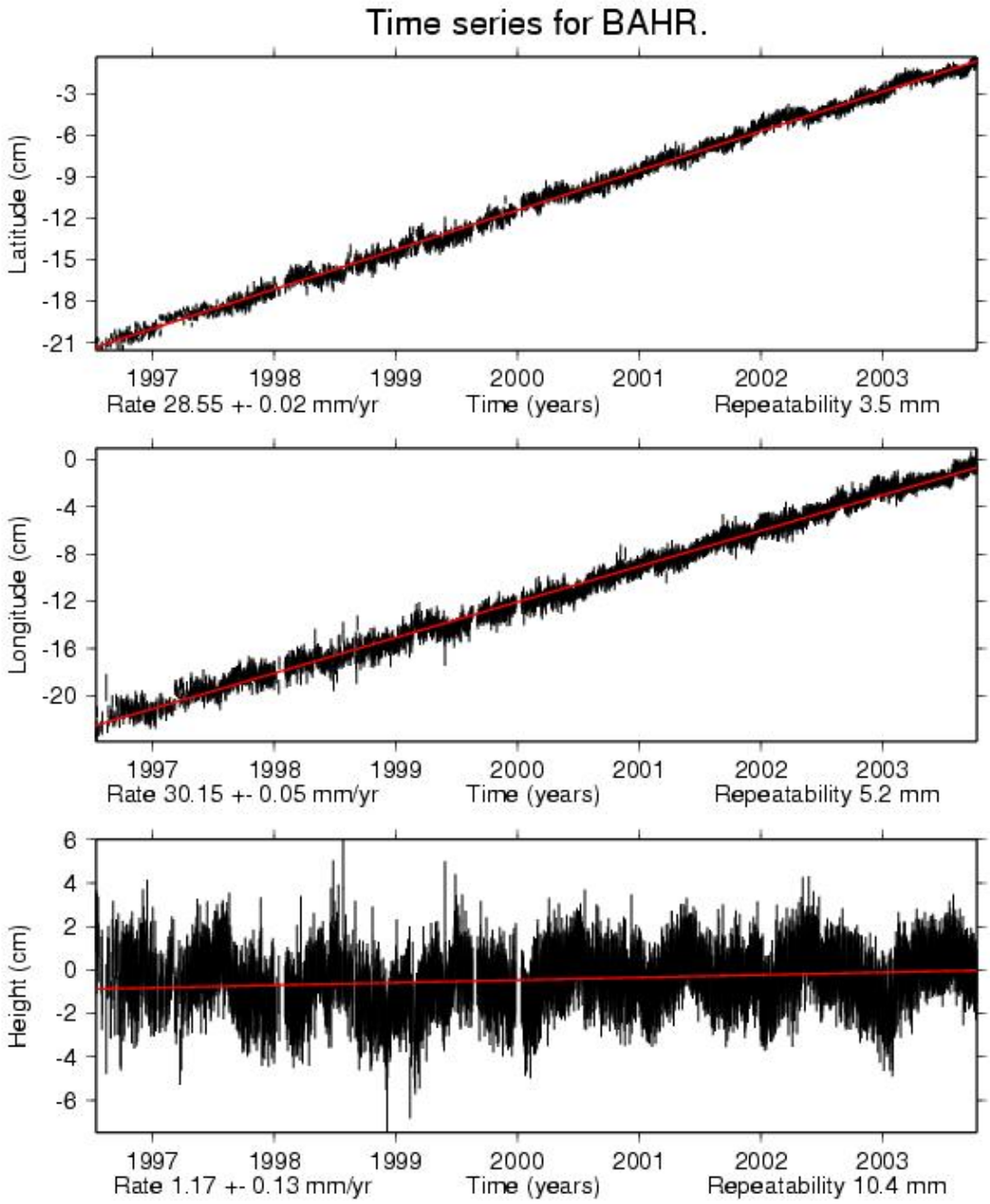
Session 332	3-parameter fit residulas		
Station	N(mm)	E(mm)	U(mm)
NSSP	0,8	3,7	-16,3
KIT3 12334M001	4,0	5,6	-11,5
ZECK 12351M001	-0,3	-1,1	-13,3
GLSV 12356M001	0,3	-2,7	5,0
NICO 14302M001	-2,1	0,7	7,3
ANKR 20805M002	-2,3	14,3	-29,3
TRAB 20808M001	2,3	-13,8	57,0
BAHR 24901M002	-2,7	-1,3	2,2
RMS / COMPONENT	2,4	8,0	26,1

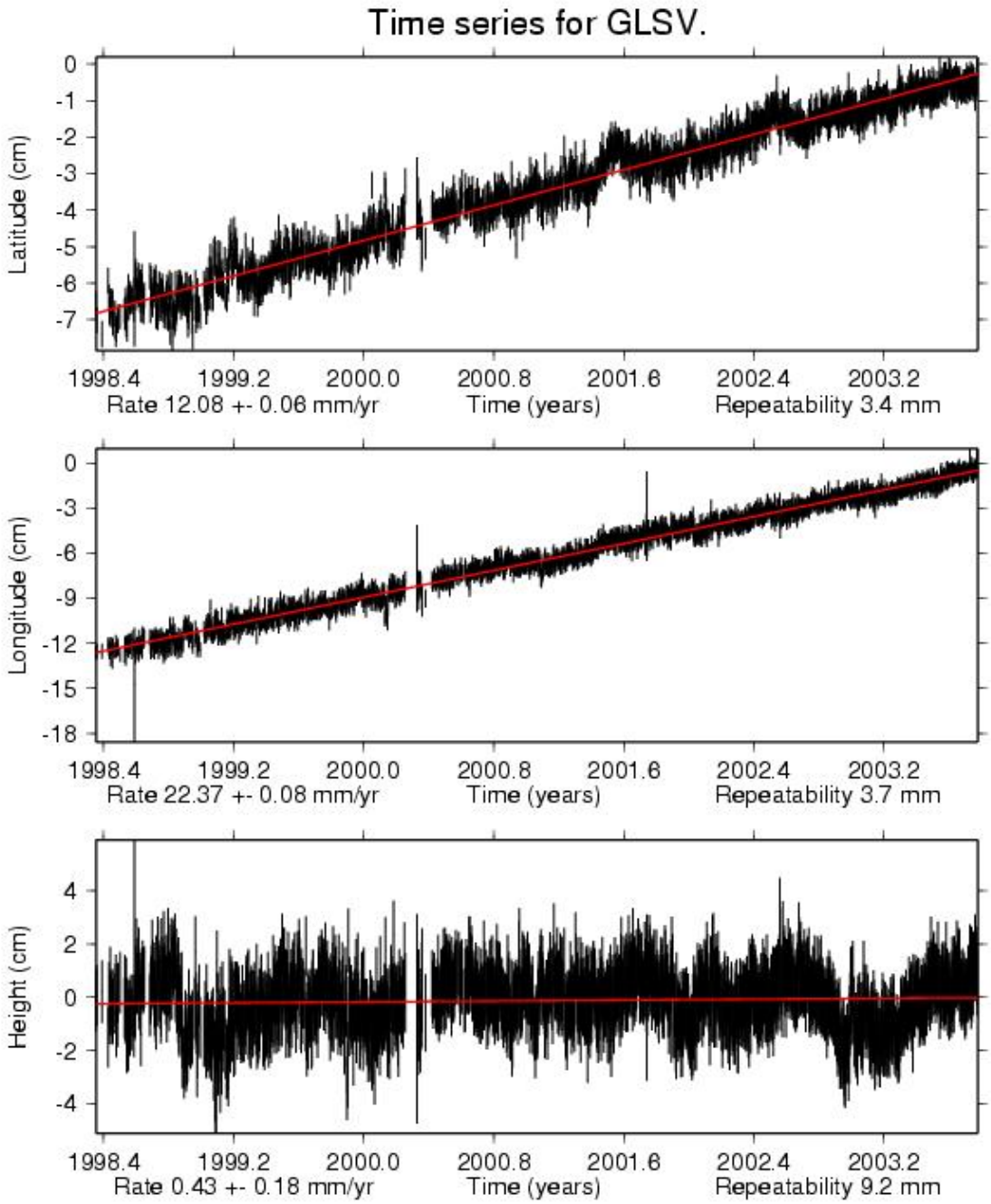
Session 333	3-parameter fit residulas		
Station	N(mm)	E(mm)	U(mm)
NSSP	1,6	2,0	-19,7
KIT3 12334M001	3,5	6,7	-11,2
ZECK 12351M001	-1,0	0,2	-10,6
GLSV 12356M001	0,8	-2,8	10,8
NICO 14302M001	-3,3	1,9	9,5
ANKR 20805M002	-3,5	15,3	-28,7
TRAB 20808M001	0,8	-13,7	58,1
BAHR 24901M002	-2,4	-1,6	-7,3
RMS / COMPONENT	2,6	8,3	27,0

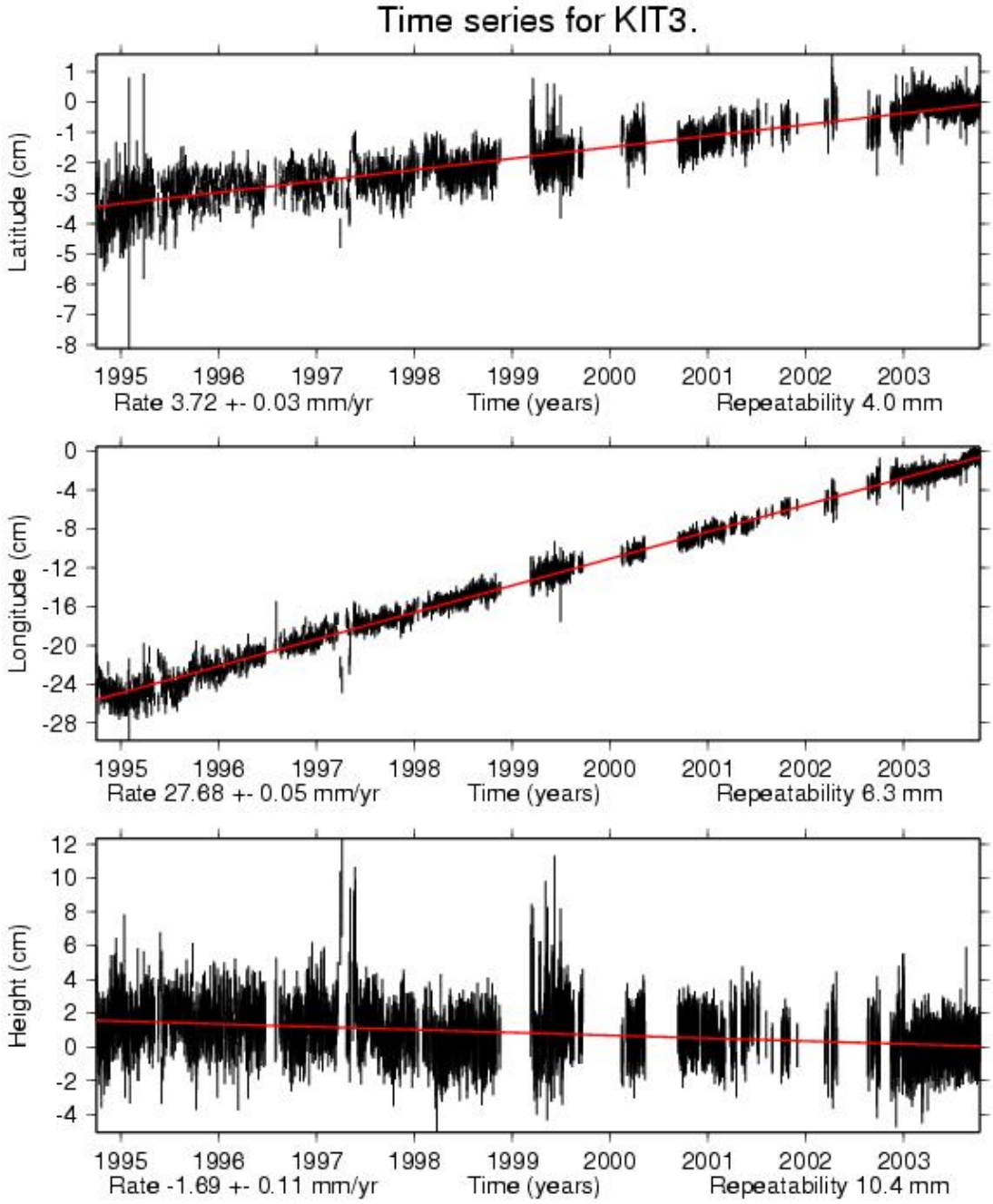
Session 334	3-parameter fit residulas		
Station	N(mm)	E(mm)	U(mm)
NSSP	0,9	1,8	-26,3
KIT3 12334M001	3,2	6,4	1,0
ZECK 12351M001	-0,1	-0,8	-9,1
GLSV 12356M001	1,7	-4,7	7,7
NICO 14302M001	-1,3	0,5	1,6
ANKR 20805M002	-2,9	14,2	-34,3
TRAB 20808M001	1,4	-13,7	55,3
BAHR 24901M002	-3,7	-4,2	6,4
RMS / COMPONENT	2,4	8,2	27,0

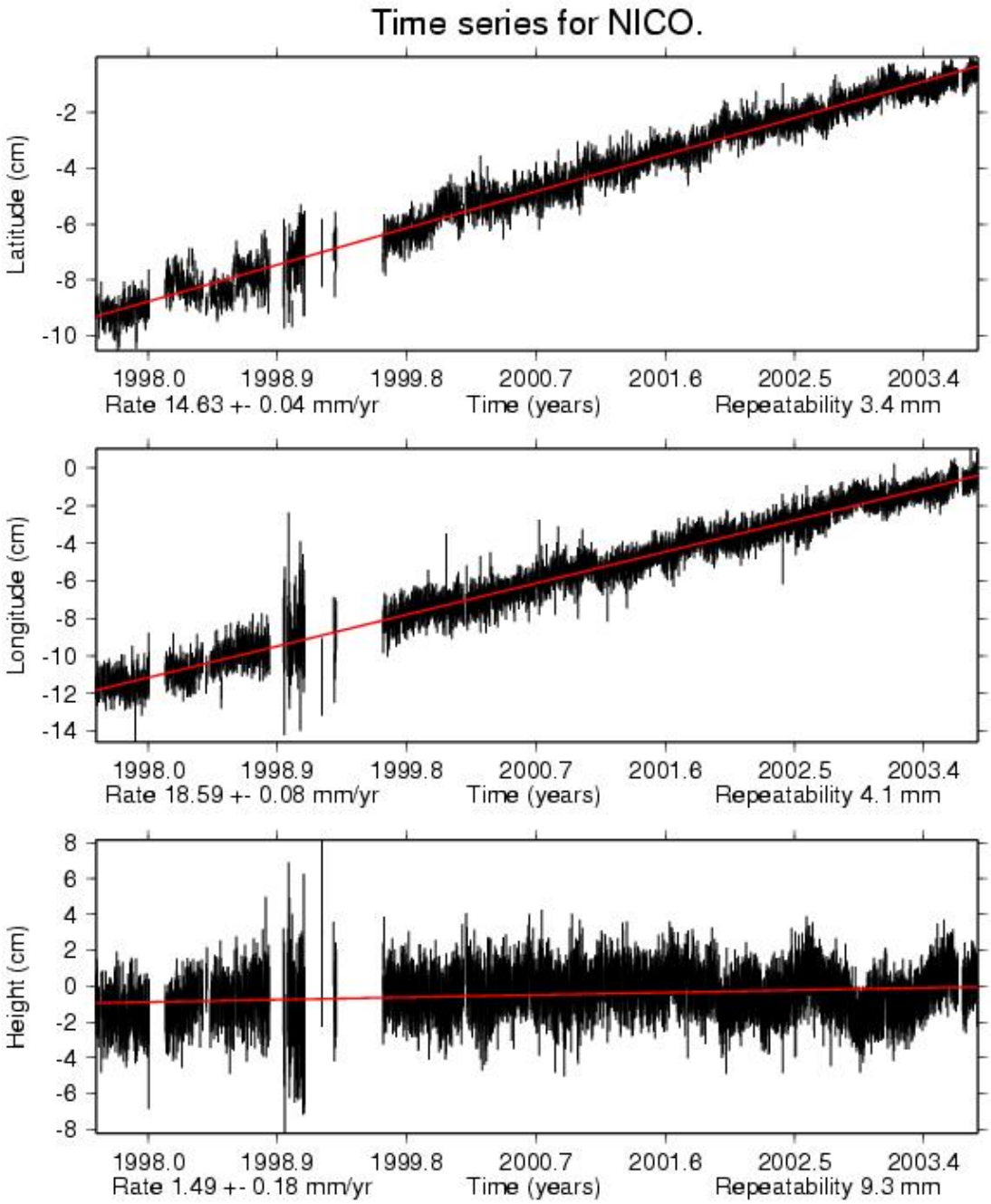
Appendix 5: Time Series for the EPN/IGS Stations

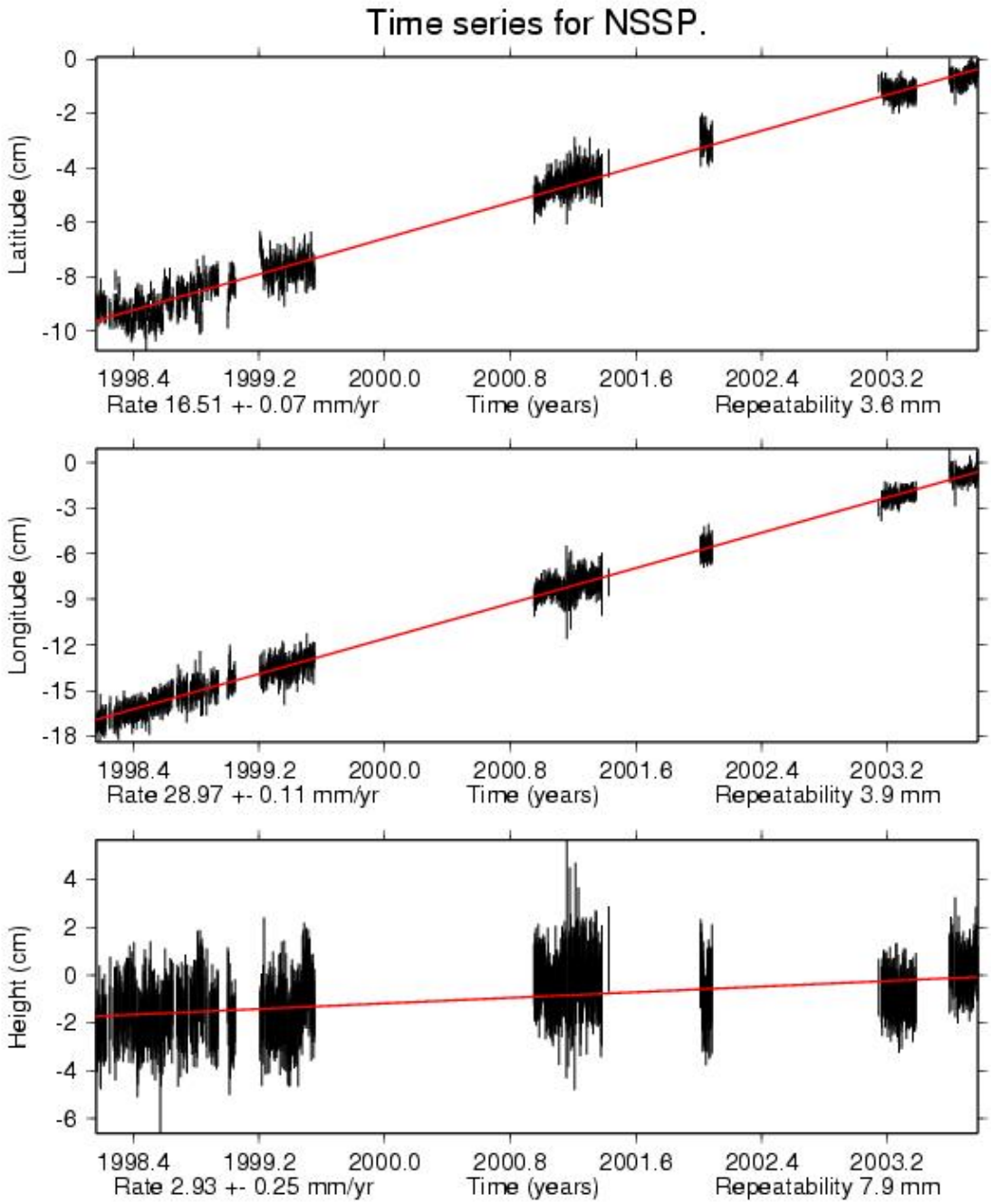


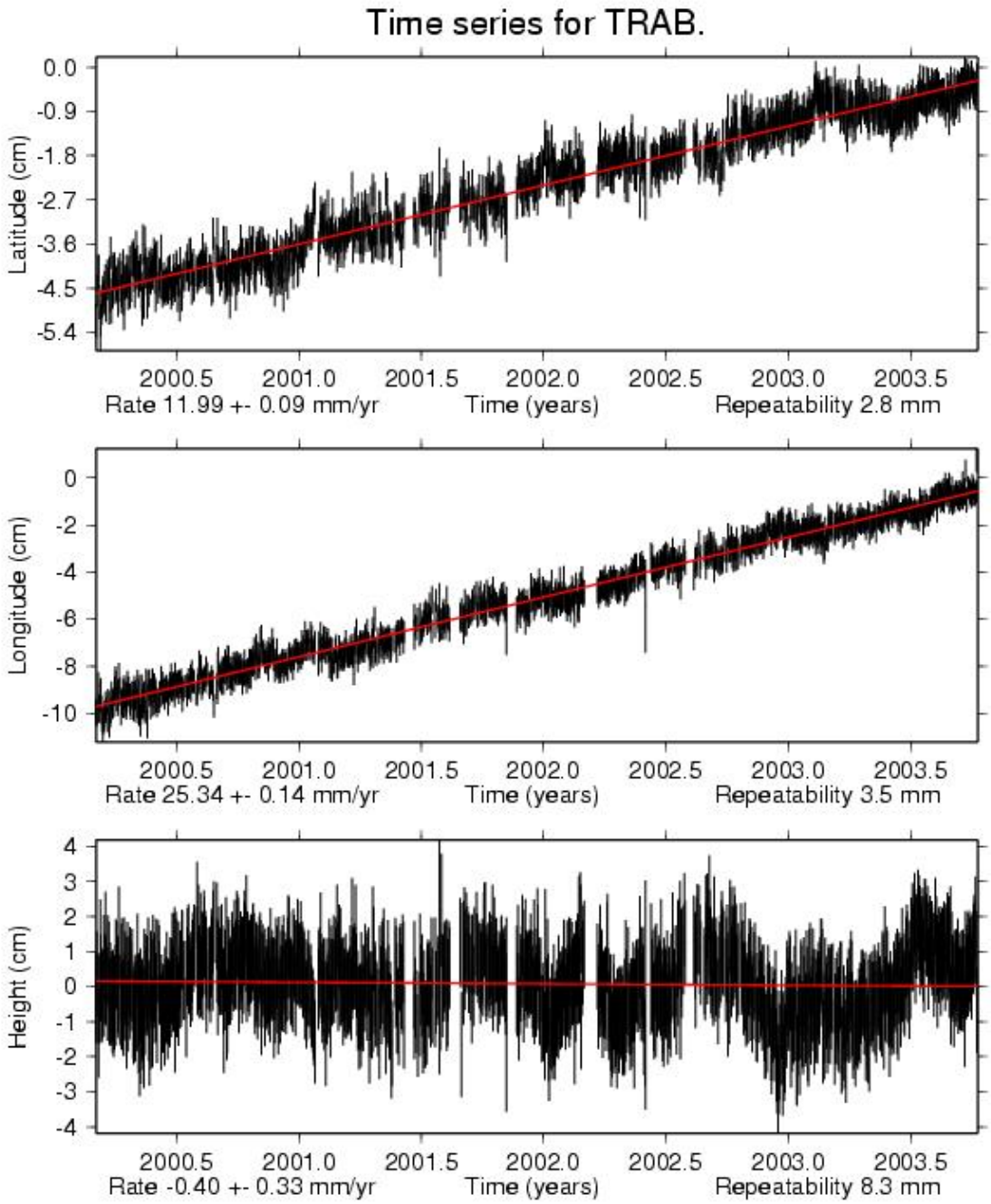

Time series for BAHR.
Latitude (cm)
-3
-6
-9
-12
-15
-18
-21
1997
1998
1999
2000
2001
2002
2003
Rate 28.55 +- 0.02 mm/yr
Time (years)
Repeatability 3.5 mm
Longitude (cm)
0
-4
-8
-12
-16
-20
1997
1998
1999
2000
2001
2002
2003
Rate 30.15 +- 0.05 mm/yr
Time (years)
Repeatability 5.2 mm
Height (cm)
6
4
2
0
-2
-4
-6
1997
1998
1999
2000
2001
2002
2003
Rate 1.17 +- 0.13 mm/yr
Time (years)
Repeatability 10.4 mm

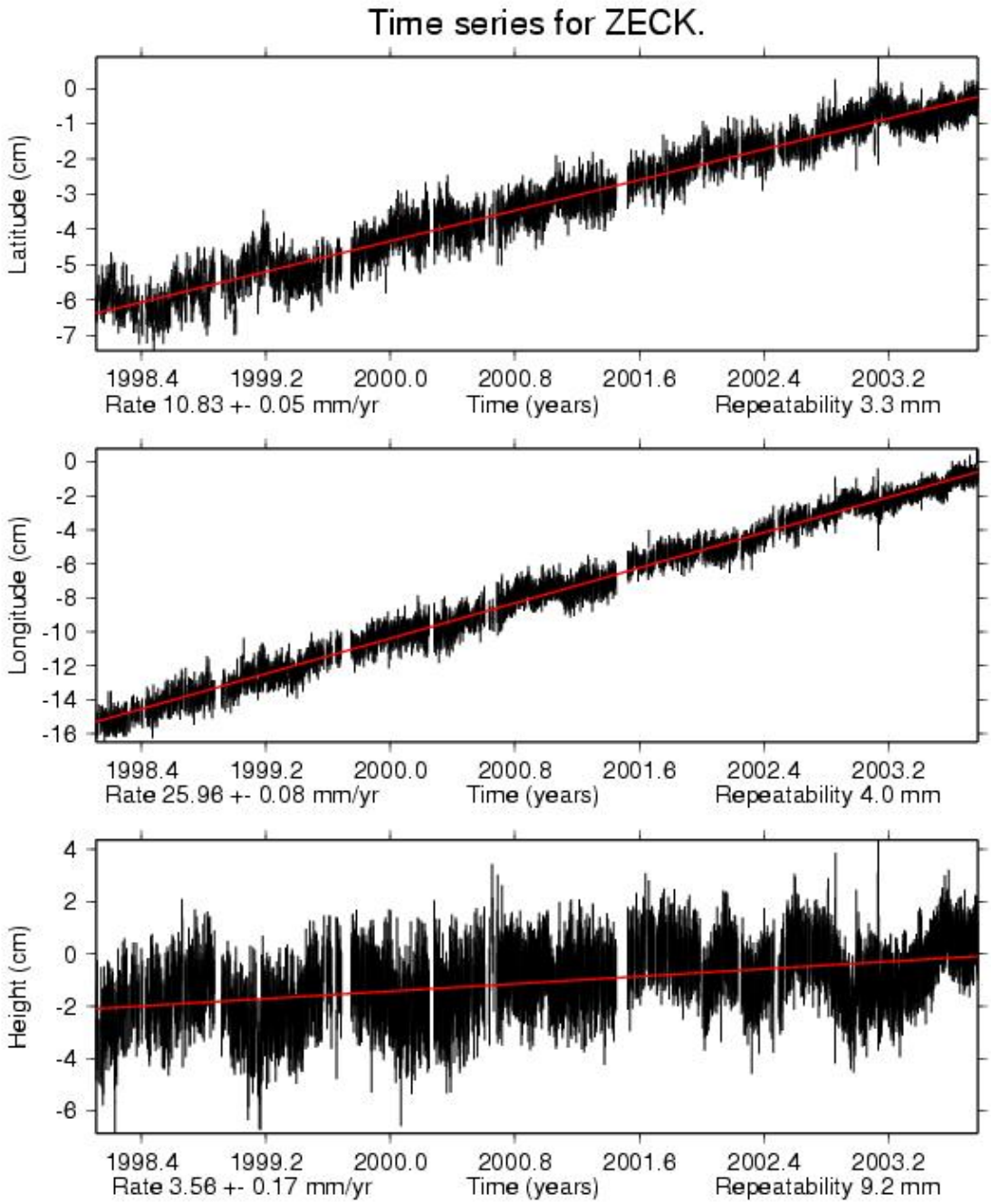

Time series for GLSV.
Latitude (cm)
0
-1
-2
-3
-4
-5
-6
-7
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 12.08 +- 0.06 mm/yr
Time (years)
Repeatability 3.4 mm
Longitude (cm)
0
-3
-6
-9
-12
-15
-18
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 22.37 +- 0.08 mm/yr
Time (years)
Repeatability 3.7 mm
Height (cm)
4
2
0
-2
-4
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 0.43 +- 0.18 mm/yr
Time (years)
Repeatability 9.2 mm


Time series for KIT3.
Latitude (cm)
1
0
-1
-2
-3
-4
-5
-6
-7
-8
1995 1996 1997 1998 1999 2000 2001 2002 2003
Rate 3.72 +- 0.03 mm/yr
Time (years)
Repeatability 4.0 mm
Longitude (cm)
0
-4
-8
-12
-16
-20
-24
-28
1995 1996 1997 1998 1999 2000 2001 2002 2003
Rate 27.68 +- 0.05 mm/yr
Time (years)
Repeatability 6.3 mm
Height (cm)
12
10
8
6
4
2
0
-2
-4
1995 1996 1997 1998 1999 2000 2001 2002 2003
Rate -1.69 +- 0.11 mm/yr
Time (years)
Repeatability 10.4 mm


Time series for NICO.
Latitude (cm)
-2
-4
-6
-8
-10
1998.0
1998.9
1999.8
2000.7
2001.6
2002.5
2003.4
Rate 14.63 +- 0.04 mm/yr
Time (years)
Repeatability 3.4 mm
Longitude (cm)
0
-2
-4
-6
-8
-10
-12
-14
1998.0
1998.9
1999.8
2000.7
2001.6
2002.5
2003.4
Rate 18.59 +- 0.08 mm/yr
Time (years)
Repeatability 4.1 mm
Height (cm)
8
6
4
2
0
-2
-4
-6
-8
1998.0
1998.9
1999.8
2000.7
2001.6
2002.5
2003.4
Rate 1.49 +- 0.18 mm/yr
Time (years)
Repeatability 9.3 mm


Time series for NSSP.
Latitude (cm)
0
-2
-4
-6
-8
-10
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 16.51 +- 0.07 mm/yr
Time (years)
Repeatability 3.6 mm
Longitude (cm)
0
-3
-6
-9
-12
-15
-18
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 28.97 +- 0.11 mm/yr
Time (years)
Repeatability 3.9 mm
Height (cm)
4
2
0
-2
-4
-6
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 2.93 +- 0.25 mm/yr
Time (years)
Repeatability 7.9 mm


Time series for TRAB.
Latitude (cm)
0.0
-0.9
-1.8
-2.7
-3.6
-4.5
-5.4
2000.5
2001.0
2001.5
2002.0
2002.5
2003.0
2003.5
Rate 11.99 +- 0.09 mm/yr
Time (years)
Repeatability 2.8 mm
Longitude (cm)
0
-2
-4
-6
-8
-10
Rate 25.34 +- 0.14 mm/yr
Repeatability 3.5 mm
Height (cm)
4
3
2
1
0
-1
-2
-3
-4
Rate -0.40 +- 0.33 mm/yr
Repeatability 8.3 mm


Time series for ZECK.
Latitude (cm)
0
-1
-2
-3
-4
-5
-6
-7
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 10.83 +- 0.05 mm/yr
Time (years)
Repeatability 3.3 mm
Longitude (cm)
0
-2
-4
-6
-8
-10
-12
-14
-16
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 25.96 +- 0.08 mm/yr
Time (years)
Repeatability 4.0 mm
Height (cm)
4
2
0
-2
-4
-6
1998.4
1999.2
2000.0
2000.8
2001.6
2002.4
2003.2
Rate 3.56 +- 0.17 mm/yr
Time (years)
Repeatability 9.2 mm

Appendix 6: Resulting Co-ordinates from the Minimum Constrained Solution Fitted by a 3-parameter Transformation to ITRF 2000 epoch 2002.9.

TRAB and ANKR not used for the fit

ARMENIA 0:ORDER MINCON ZECK CONSTR 10 DEG ELW 15-DEC-03 12:08

LOCAL GEODETIC DATUM: ITRF00 EPOCH: 2002-11-28 14:00:30

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
916	NSSP	3478646.7066	3418805.8273	4097987.2246	M
911	AMAS	3484623.1876	3331342.0101	4165484.7785	M
137	ANKR 20805M002	4121948.5657	2652187.9221	4069023.7426	M
138	BAHR 24901M002	3633908.8683	4425275.5187	2799861.4207	M
139	GLSV 12356M001	3512889.0060	2068979.8518	4888903.1784	M
914	KAPA	3410609.3978	3587102.0718	4010241.1144	M
136	KIT3 12334M001	1944945.2016	4556652.2387	4004325.9881	M
140	NICO 14302M001	4359415.7625	2874117.0491	3650777.7896	M
912	NOYE	3400873.7155	3399050.8339	4177960.8074	M
141	TRAB 20808M001	3705250.4200	3084421.6656	4162044.7352	M
913	VARD	3407717.4906	3496826.7950	4093065.7982	M
142	ZECK 12351M001	3451174.7606	3060335.4138	4391955.6229	W

Appendix 7: Resulting Co-ordinates from the Constrained Solution in ITRF 2000 epoch 2002.9

TRAB and ANKR not constrained

ARMENIA 0:ORDER CONSTR (NOT TRAB,ANKR) 10 DEG ELW 15-DEC-03 12:14

LOCAL GEODETIC DATUM: IGS00 EPOCH: 2002-11-28 14:00:30

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
916	NSSP	3478646.6975	3418805.8208	4097987.2159	W
911	AMAS	3484623.1853	3331342.0086	4165484.7762	M
137	ANKR 20805M002	4121948.5639	2652187.9209	4069023.7408	M
138	BAHR 24901M002	3633908.8728	4425275.5215	2799861.4211	W
139	GLSV 12356M001	3512889.0099	2068979.8529	4888903.1852	W
914	KAPA	3410609.3954	3587102.0703	4010241.1121	M
136	KIT3 12334M001	1944945.1973	4556652.2372	4004325.9882	W
140	NICO 14302M001	4359415.7697	2874117.0548	3650777.7942	W
912	NOYE	3400873.7130	3399050.8323	4177960.8050	M
141	TRAB 20808M001	3705250.4178	3084421.6643	4162044.7332	M
913	VARD	3407717.4880	3496826.7933	4093065.7958	M
142	ZECK 12351M001	3451174.7584	3060335.4119	4391955.6195	W

Appendix 8: Daily Repeatability for the 15°-solution

913	VARD		5	N	0.7	-0.7	-0.1	0.2	-0.6	1.1
				E	0.5	-0.5	0.0	0.5	0.5	-0.5
				U	6.2	8.1	-7.2	-1.9	-3.6	4.7
912	NOYE		5	N	0.4	0.2	-0.1	0.0	-0.7	0.5
				E	0.6	-0.7	-0.4	0.3	0.8	0.1
				U	4.9	4.0	4.4	0.8	-7.5	-1.6
914	KAPA		5	N	1.1	0.2	-0.6	-0.2	-1.2	1.7
				E	0.8	-0.7	0.8	0.0	0.7	-0.8
				U	8.1	11.8	-10.3	2.5	-0.9	-3.2
911	AMAS		5	N	0.4	0.3	0.3	-0.1	-0.6	0.1
				E	0.8	-1.1	-0.2	0.9	0.6	-0.3
				U	4.3	1.1	-4.6	2.7	-4.3	5.0
916	NSSP		5	N	0.9	-0.3	0.0	0.7	-1.4	0.9
				E	1.7	-2.0	-1.4	0.1	1.9	1.4
				U	5.9	1.1	-5.9	-4.3	-0.2	9.2
136	KIT3	12334M001	5	N	0.6	-0.7	0.2	-0.2	-0.2	0.9
				E	0.9	0.1	-0.1	1.1	0.4	-1.5
				U	2.5	1.7	2.6	-1.5	0.9	-3.7
142	ZECK	12351M001	5	N	0.0	0.0	0.0	0.0	0.0	0.0
				E	0.0	0.0	0.0	0.0	0.0	0.0
				U	0.0	0.0	0.0	0.0	0.0	0.0
139	GLSV	12356M001	5	N	3.7	-1.2	-5.5	4.7	1.1	0.9
				E	1.5	-2.0	-0.5	-0.2	0.6	2.1
				U	4.1	2.2	5.6	-2.3	-5.1	-0.5
140	NICO	14302M001	5	N	0.3	0.2	-0.5	0.0	0.4	-0.1
				E	0.8	-1.0	-0.2	-0.1	0.1	1.2
				U	5.4	-0.5	-0.5	-5.8	-2.1	8.8
138	BAHR	24901M002	5	N	1.3	-0.8	0.1	-0.5	-1.1	2.3
				E	2.0	-0.5	2.5	-2.3	1.7	-1.4
				U	4.6	6.3	-0.4	-3.1	2.5	-5.4
137	ANKR	20805M002	5	N	0.5	0.7	-0.4	-0.4	-0.2	0.2
				E	0.6	-0.9	0.2	-0.1	0.2	0.6
				U	4.0	2.6	-0.4	-4.7	-2.7	5.2
141	TRAB	20808M001	5	N	1.0	1.4	-1.1	-0.6	-0.1	0.4
				E	1.0	-1.2	-0.8	0.2	1.4	0.4
				U	2.4	0.7	-3.6	0.0	-0.1	3.0

Appendix 9: Fit of 15°-solution to IERS ITRF 2000 epoch 2002.9

Translation (3-parameter) to IERS ITRF 2000 epoch 2002.9

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS			
916	NSSP	I M	0.7	2.3	-11.5	
136	KIT3 12334M001	I M	3.0	2.5	4.4	
142	ZECK 12351M001	I W	-2.4	-0.8	-3.6	
139	GLSV 12356M001	I M	-0.3	-1.0	7.0	
140	NICO 14302M001	I M	-1.9	3.1	7.8	
137	ANKR 20805M002	I M	-3.7	16.6	-24.5	M
141	TRAB 20808M001	I M	-0.1	-12.3	60.7	M
138	BAHR 24901M002	I M	-0.5	-3.5	-3.5	
	RMS / COMPONENT		2.0	2.6	7.6	

NUMBER OF PARAMETERS : 3
NUMBER OF COORDINATES : 18
RMS OF TRANSFORMATION : 4.8 MM

Helmert-fit (6-parameter) to IERS ITRF 2000 epoch 2002.9

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS			
916	NSSP	I M	0.9	2.1	-11.6	
136	KIT3 12334M001	I M	1.7	1.9	6.1	
142	ZECK 12351M001	I W	-2.0	-0.7	-4.6	
139	GLSV 12356M001	I M	0.9	-0.8	3.8	
140	NICO 14302M001	I M	-1.3	2.6	7.4	
137	ANKR 20805M002	I M	-2.9	16.3	-25.8	M
141	TRAB 20808M001	I M	0.3	-12.5	59.9	M
138	BAHR 24901M002	I M	-0.2	-4.6	-0.5	
	RMS / COMPONENT		1.4	2.7	7.3	

NUMBER OF PARAMETERS : 6
NUMBER OF COORDINATES : 18
RMS OF TRANSFORMATION : 5.1 MM

Appendix 10: Bernese GPS Software

The Bernese GPS Software is a sophisticated tool meeting the highest quality standards for geodetic and further applications using the GPS as well as GLONASS. The software is developed at the Astronomical Institute at the University of Berne.

The software package is particularly well suited for:

- Rapid processing of small-size single and dual frequency surveys
- Permanent network processing
- Ambiguity resolution on long baselines (up to 2000 km using high accuracy orbits)
- Ionosphere and troposphere modelling
- Clock estimation and time transfer
- Combination of different receiver types (taking into account antenna phase centre variations)
- Simulation studies
- Orbit determination and estimation of Earth rotation parameters
- Generation of so-called free network solutions

Version 4.2 was released in the end of 1999.

The Bernese GPS Software is by several analysis centres of International GPS Service (IGS) and Permanent EUREF (EPN).

Appendix 11: Station Abbreviations

Full name	4-char abbreviation	Domes number
Ankara	ANKR	20805M002
Bahrain	BAHR	24901M002
Kiev/Golosiiv	GLSV	12356M001
Kitab	KIT3	12334M001
Nicosia-Athalassa	NICO	14302M001
Yerevan	NSSP	12231M001
Trabzon	TRAB	20808M001
Zelenchukskaya	ZECK	12351M001
Amasia	AMAS	
Kapan	KAPA	
Noyemberyan	NOYE	
Vardenis	VARD	